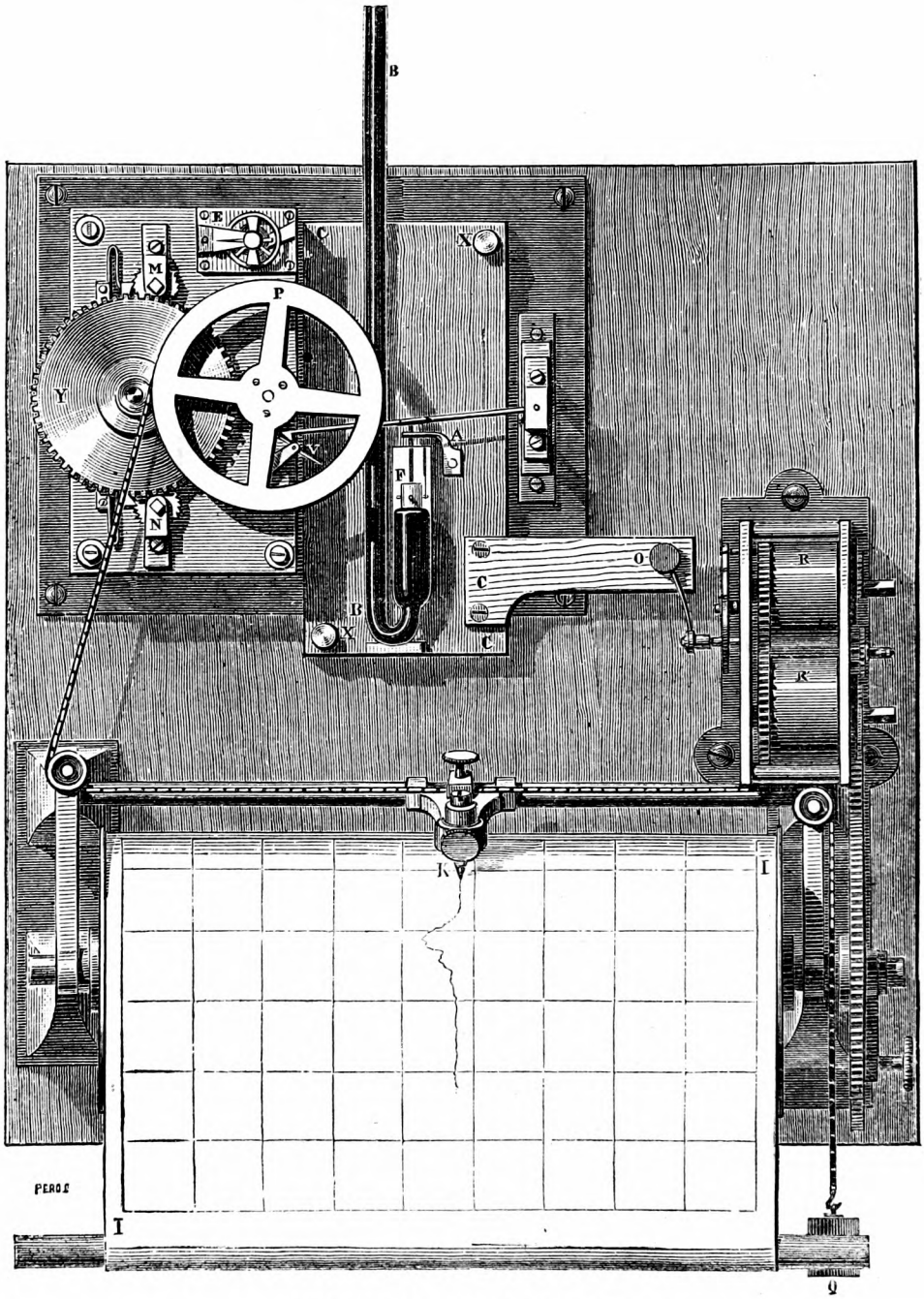

REDIER'S BAROGRAPH.

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THE RAINFALL AND THE SUGAR CROP OF BARBADOS.*

WE ought perhaps to apologize for the long delay which has occurred before noticing this excellent monograph, but we have been waiting in the hope that even after issuing it, Governor Rawson might have seen his way to supplying that which to those unacquainted with the Island is almost indispensable, namely, a map of the stations. We can quite understand that such a production might have been beyond the resources of Barbados printers, (although they seem to do their work well,) but Governor Rawson has surely plenty of friends in this country who would gladly have seen such a map through the press for him, if he had supplied the original MS. We regret its absence all the more, because, as we hope to show, the report is in other respects exceptionally good.

Before proceeding to examine the results, and premising that both in its size (166 square miles against 136,) and in the elevation of its highest point (1104 ft., against 835 ft.) Barbados closely resembles the Isle of Wight; we leave the Governor to describe its position and physical characteristics:—

"Barbados is an oblong Island, of greater length (from North to South), than breadth, say—21 by 14 miles. Its area is 166 square miles, or 106,470 acres. It is situated in N. latitude, 13 deg. 4 min., and W. longitude, 59 deg. 37 min., about 80 miles outside, and Eastward, of the belt of Islands forming the Windward, or more Southern, portion of the group which encircles the Caribbean sea on its Eastern side. The greater part, about seven-eighths, consists of a succession of limestone and coral terraces, the sides of which often bear evidence of having once been shore cliffs, and resting upon a clay foundation. These do not rise in the highest point above 1,147 feet.† This part is intersected by numerous ravines and gullies. The primitive forests, of which there are both physical and historical evidence, have disappeared. Scarcely a vestige of them remains; and outside of Bridgetown, with the exception of a few acres of wood in two or three parts of the island, several small copses of young mahogany trees, the remnants

* Report upon the Rainfall of Barbados, and upon its influence upon the Sugar Crops, 1847–71, with two supplements 1873–4, by Governor Rawson, C.B. Presented to, and ordered to be printed by, the House of Assembly of Barbados, 1874. Folio, 167 pages.

† Height of Mount Hillaby by old survey, reduced to 1,104 ft. by the recent trigonometrical survey of Staff Commander Parsons, R.N.

of alleys of cabbage palms, and small clumps of ornamental trees surrounding most of the country residences, the island is denuded of trees. It presents one vast cultivated field, undivided except by roads, planted with sugar canes, or grain and root crops, with rare and very small patches of pasture land, covered with sour grass, on most of which the soil is too scanty for cultivation. Of lakes there are none; streamlets, scarcely any; the ponds, once numerous, are rapidly disappearing, being exhausted and taken into cultivation.

"The smaller portion, which is on the windward side, differs in the absence of the horizontal limestone and coral strata, in its irregular and broken structure, resembling 'a miniature alpine country.' Its aspect, surrounded by the limestone and coral rocks of the highest section of the island, which assume in many parts the abruptness and height of cliffs, is as if the calcareous superstructure had been torn off, and cast out of sight, by some convulsion of nature, possibly volcanic, as if the foundation of the whole island, had in this part of it been left bare, and had assumed its present superficial appearance from the action of the weather through successive centuries. Coralline boulders remain on the beach and elsewhere, but whether they formed part of the original covering of this district, or have rolled down from the cliffs still overhanging it, may be a question.

"The island is exposed to the trade winds, varying but slightly from N.E., during three-fourths of the year. The rain comes chiefly from the same quarter, but at certain seasons occasional shifts of wind to the S.W. and N.W. bring with them heavy showers, which generally do not reach the windward side. The island lies nearly in the latitude in which the circular storms of the northern hemisphere are supposed to be generated. The majority of them assume their destructive force to the northward of the island, or pass by it to the N.E. Few comparatively have swept the island in their westerly course, or recurved upon it from the N.E. Fewer still have passed by it to the Southward.

"There is little in the surface of the island to attract, or to promote the generation of, rain. The faces of terraced cliffs of coral rock are likely to increase the rainfall in their immediate neighbourhood. But for the most part the rainfall depends, apart from elevation, upon the exposure of the land to those winds which at different seasons of the year strike the island laden with moisture, and discharge their burthen on the lands which they first meet. It happens very rarely that rain falls over the whole island at the same time, or in equal proportions."

In this little Island 178 stations were at work when this report was written, a number which has since been raised to 225, or rather more than one station to each square mile. This is a very much closer network of stations than is necessary in the British Isles, where with 120,000 square miles, we have about 1,700 stations, or about one station to each 70 square miles. The stations in Barbados are therefore more than seventy times as numerous as they are on the average in the British Isles. We do not quite understand the necessity for such extreme proximity, but the Governor has had longer experience in the Island than we have, and we therefore raise no objection on this score.

The report contains in various appendices, abstracts of nearly all the rainfall observations made in the Island; and in this respect it is an invaluable storehouse of facts. For three stations the daily observations are printed *in extenso*, from 1847 to 1872, and another appendix gives all the yearly totals observed between 1843 and 1871 inclusive, at 57 stations. This is an extremely important table. On scientific grounds, however, we must protest against the mode of averaging which has been adopted, viz., the quotient of the summation of each series of totals divided by the number of years—the averages

are therefore averages of periods of unequal length, varying from 4 years to 25 years, and as some include wet periods, and some do not, the resultant averages are not properly comparable. This error is so frequent, nay so rarely avoided, in similar tables, that it may be well to point out its serious nature by a fully worked out example, taken from three consecutive columns of the table under notice.

Years.	St. James, Leeward Lowland.			Differences from Sion Hill.	
	Sion Hill.	Westmoreland.	Holders.	Westmoreland.	Holders.
1857 ...	98·83				
8 ...	66·54				
9 ...	71·33				
1860 ...	79·81				
1 ...	84·40				
2 ...	96·42				
3 ...	63·81				
4 ...	71·76				
5 ...	79·79	82·17	...	+2·38	
6 ...	63·34	67·95	...	+4·61	
7 ...	79·31	84·80	...	+5·49	
8 ...	55·32	55·84	37·95	+ ·52	—17·37
9 ...	60·73	58·89	39·78	—1·84	—20·95
1870 ...	75·06	66·38	55·39	—8·68	—19·67
1 ...	48·53	46·38	39·16	—2·15	— 9·37
Average of whole periods	73·00	65·60	43·06		
Average 1865-71	66·01	66·06	...	+ ·05	
,, 1868-71	59·91	56·87	43·07	—3·04	—16·84

The portion of the above table within the dotted line is reprinted *literatim* from the report; if, however the yearly amounts, are correctly printed, the averages of the third and fourth columns should be 66·06 and 43·07 respectively. These, however, are relatively small differences, the salient feature is that the averages at the three stations are given as (to take the nearest inch), 73, 66 and 43. That is, that Sion Hill exceeds Holders by thirty inches, and Westmoreland exceeds it by twenty-three. If, however, we look at column five we shall find that Westmoreland and Sion Hill agree on an average within 0·05 in., and finally we find that during the five years in which observations were made simultaneously at all three stations, the first two exceed the last by seventeen and fourteen inches respectively, instead of by thirty and twenty-three as shown in the table.

As the errors due to this principle are equally likely to be *nil*, or + or −, it is probable that, were all the averages recomputed on the latest and best mode, they would agree in their general character with the present values, though individual ones might be raised or lowered by five or ten inches. Taking, however, the amounts as they are (and

we know of no equal area on the globe for which there are such full details,) it appears that the lower terraces all round the Island, receive about 52 inches per annum, rather less in the south-west (perhaps 47) and more (about 55) in the N.W. On the highlands in the interior the amount reaches 70 inches. This might have been anticipated from the elevation, for take it at 1000 feet and take the increase due to elevation at the ordinary value of 4 per cent., then low level average 52·00

Add 4 per cent. for each 100 ft., 1000 ft.=40 per cent. of 52·00=	20·80
Computed fall for 1000 ft. =	72·80

With respect to the seasonal distribution of rain, ample details are also given. In the following abstract we have converted the average results given in the report, into per-centages of the yearly total, which is by far the most easily intelligible way of considering seasonal distribution.

Amounts.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Average												
Highlands...	3·80	3·00	1·73	2·33	3·96	6·07	6·13	7·76	6·61	9·17	7·42	5·07
Lowlands ...	2·97	2·34	1·32	1·81	3·23	5·09	5·51	7·06	6·05	8·49	6·85	4·24
Per Centages.												
Average												
Highlands ...	6	5	3	4	6	9	10	12	10	15	12	8
Lowlands ...	6	4	2	3	6	9	10	13	11	15	13	8

From this it appears that the mean monthly rainfall steadily rises (September excepted,) from a minimun in March to a maximum in October, and then falls, more rapidly, to the above-mentioned March minimum.

We must now proceed from the Meteorological to the practical part of this able report, for Governor Rawson has proved that the sugar crop is calculable from the rainfall. As it is impossible in the limits of this article to discuss at length the exhaustive mode in which Governor Rawson has worked out this subject, we must quote such paragraphs as will give a general idea of the mode of investigation and of its results.

INFLUENCE OF RAINFALL ON CROPS.

"The next subject for consideration is the practical application of the information above detailed in examining its influence upon the staple crop—the sugar crop—of the island. The means of gauging this are accessible. Almost the whole of the sugar manufactured, probably within two per cent. of a good crop, or five per cent. of a bad one, is exported. It is generally shipped within the year in which it is manufactured. If otherwise, the Customs have the means of distinguishing the small remnant, and of including it in the crop to which it belongs. These records have been kept systematically for many years, since 1806, exactly two-thirds of a century. A return of the quantity in each year, 1806—1872, is contained in Appendix No. 28. The rainfall returns do not extend beyond 1847. But fortunately for the object of this inquiry, the absence of earlier Returns is of less consequence, as during the first half of the century various circumstances besides the Rainfall affected the crop of the season, such as the extension of cultivation, the abandonment of root-crops for the food of the slaves and

apprentices, which were generally grown up to 1838, improved methods of cultivation or processes of manufacture, and the influence of a fluctuating legislation affecting the sugar market, and encouraging or discouraging the employment of capital on the production and manufacture of the article. During the years immediately preceding and following Emancipation the crops were more or less affected by the irregularity of labour."

"The actual excess or deficiency, in inches, of the Rainfall in the years preceding the several years, ranged according to their crop, was as follows :—

Years.	Crops of year.		Rainfall of preceding year compared with average.	
	Above average.	Below average.	Inches above.	Inches below.
1868	29 per cent.	...	12·19	...
66	27 ,,	...	10·90	...
52	25 ,,	...	1·66	...
71.....	20 ,,	...	2·43	...
54.....	17 ,,	...	11·10	...
67.....	14 ,,	...	1·94	...
58.....	13 ,,	...	3·16	...
56.....	11 ,,	...	19·57	...
61.....	10 ,,	...	·17	...
62.....	2 ,,	...	1·66	...
65.....	2 ,,	...	1·45	...
55.....	1 ,,	...	...	6·86
51.....	average.		10·14	...
53.....			1·03	...
60.....	...	5 per cent.	...	3·52
63.....	...	6 ,,	1·53	...
50.....	...	9 ,,	...	4·97
59.....	..	12 ,,	...	12·52
70.....	...	13 ,,	...	9·22
57	...	14 ,,	...	9·25
49.....	...	15 ,,	6·03	...
64.....	...	17 ,,	...	15·36
48.. ...	...	27 ,,	...	9·64
69.....	...	28 ,,	...	13·14

"It only remains to show how the crop of any year may be measured by the Rainfall of the preceding year, with such an approach to accuracy in all but very exceptional years as to give a practical utility to the formula. The factors may require to be changed from time to time, as circumstances arise to affect either the area of land under canes, or the forms of cultivation or manufacture. But changes in these are not likely to be frequent or sudden in Barbados, and when they commence, their influence upon the crop will not be very rapid."

"The details of this calculation, and the process by which the amount of error was ascertained, are furnished in the following Table :—

Years.	Rainfall in inches.	Actual crop of following year.	Crop calculated at 800 Hhds. to the inch.	Difference between calculated and actual crop.	Per-centage of Difference.		Crop calculated at 800 Hhds. to the inch, with 7½ per cent. added or subtracted.	Difference between calculated and actual crop.	
		Hhds.	Hhds.	Hhds.	+	—	Hhds.	Hhds.	per cent.
1856...	48·49	38,798	38,792	— 6	Equal.		41,701	+2,903	+ 7·4
57...	60·90	50,788	54,720	— 2,068	...	4·0	50,616	— 172	— 0·3
58...	45·22	39,666	36,176	— 3,490	...	8·8	37,889	—1,777	— 4·4
59...	54·22	42,684	43,376	+ 692	1·4	..	46,628	+3,944	+ 9·2
60...	57·91	49,745	46,328	— 3,417	..	6·8	49,808	+ 63	+ 0·1
61...	73·82	46,120	59,056	+12,936	28·0	...	..	...	...
62...	59·27	42,281	47,416	+ 5,135	12·2	...	43,861	+1,580	+ 3·6
63...	42·38	36,199	33,904	— 2,295	...	6·3	36,456	+ 257	+ 0·7
64...	59·19	46,068	47,352	+ 1,284	2·7	...	43,801	—2,267	— 4·9
65...	68·64	57,188	54,912	— 2,276	...	3·9	59,030	+1,842	+ 3·2
66...	59·68	51,304	47,744	— 3,560	..	6·9	51,324	+ 20	Equal.
67...	69·93	58,250	55,944	— 2,306	...	3·9	51,748	—6,502	—11·2
68...	44·60	32,150	35,680	+ 3,530	11·0	...	38,356	+6,206	+19·3
69 .	48·52	39,270	38,816	— 454	...	1·1	41,726	+2,456	+ 6·2
Averge	56·63	45,036	45,301	+ 265	...		45,611	...	...

"The almost identity of the average actual crop, for the whole period, with the average calculated at 800 hhds., is most remarkable. But individual years do not tally so closely; yet an examination of the columns showing the per centage differences between the calculated and the actual crops, affords the remarkable result that within the limits of 800 hhds. to the inch of rain and 860 hhds. (7½ per cent. on 800) there are only three out of fourteen years in which the difference amounts to 5 per cent., a difference which, in calculating a crop before a hogshead of sugar is made, is almost inconceivably small.

In the earlier portion of the above table we have corrected the somewhat numerous errors of calculation and printing, but as in one or two cases in column 8 we are not sure of the author's intention we have reprinted it and the subsequent columns *literatim*. We are, moreover, inclined to think that in the last paragraph, the clause "within the limits of 800 hhds. to the inch of rain and 860 hhds." should be 740 hhds. and 860 hhds., since from col. 8 above-mentioned the 7½ per cent. seems to be sometimes added and sometimes subtracted.

REVIEWS.

Annalen des Physikalischen Centralobservatoriums, herausgegeben von H. WILD, Jahrgang, 1872. K. Akademie der Wissenschaften, St. Petersburgh, 1874. 4to., 720 pages.

DR. WILD'S annual volume improves in quality and increases in size. In fact, its size is proportional to the vast Russian Empire, respecting the meteorological phenomena of which it gives ample and very well arranged information. Among the improvements in quality, we may specially quote the small abstract tables for the year, now given for each station. We reprint (translating and converting) that for Archangel, as a specimen of which some of our readers may be glad, and we preface it with information respecting the instruments which the Russians (in this respect so much wiser than other nations) always give.

ARCHANGEL, 1872.

Lat. 64° 33′, long. E. of Greenwich 40° 32′ (2^h 42^m 8^s).
Height of the barometers above the sea $7^m{\cdot}3$ (24·1 Russian feet).
[N.B.—The Russian and English foot is identical in length.—Ed.]
Height of the thermometers above the ground $3^m{\cdot}0$ (10 feet).
Height of the rain gauges above the ground $4^m{\cdot}9$ (16 feet).

The barometer is graduated in Russian half lines, and its indications have been converted into millimetres. The correction of the barometer is not known, but it is probably between —5 mm. and —6 mm. [between —0·197 in. and —0·236 in.]

The corrections of the centigrade thermometers No. 59^1 and 59^2 have been applied. On days when the temperature was below —25° [—13·0 F.] the humidity was computed from the hair hygrometer.

Observers—Ogorodnikof and Rastof.

Months.	Monthly and Yearly Means, from Observations at 7 a.m., 1 p.m., and 9 p.m.						Number of Days with									
	Temperature.	Elastic Force.	Relative Humidity.	Barometer	Cloud.	Depth of Rain.	Hail, Graupel Rain or Snow.	Snow and Graupel	Hail.	Fog.	Thunder and Lightning.	Strong Wind.	Sky.		Temperature.	
													Clear.	Overcast.	Min. below 32°	Max. below 32°
	deg.	in.	0—100	in.	0—10	in.										
Jan. ...	11·6	·073	92·0	30·061	8·9	2·03	17	17	...	...	...	...	...	21	31	31
Feb. ...	10·1	·070	92·0	30·186	7·3	·13	9	9	..	2	...	...	2	13	29	29
Mar. ...	12·2	·084	90·5	29·904	5·8	·82	11	11	...	..	...	6	5	7	30	26
April ...	31·8	·156	84·5	30·004	7·2	1·30	14	5	...	1	...	1	2	11	17	7
May ...	42·6	·200	72·7	29·979	6·0	1·42	12	2	...	1	1	3	2	4	5	1
June ...	54·4	·256	60·3	30·093	3·5	·28	4	1	...	...	...	...	12	2	...	...
July ...	58·9	·338	66·8	29·890	5·5	4·06	8	..	.	1	4	1	3	4	...	..
Aug. ...	58·4	·387	77·3	30·009	5·1	1·19	8	...	...	3	2	1	4	2	...	...
Sept. ...	43·6	·241	82·5	29·740	7·0	2·99	10	5	...	...	...	...	3	11	4	...
Oct. ...	38·3	·217	89·4	30·013	7·8	1·50	14	3	...	2	...	1	...	5	8	4
Nov. ...	18·3	·103	84·0	29·918	8·4	2·52	15	13	...	5	...	1	...	12	26	24
Dec. ...	8·7	·082	88·8	29·868	8·3	·79	6	6	...	2	...	5	1	10	26	23
Year ...	32·5	·183	81·7	29·972	6·7	19·03	128	72	...	17	7	19	34	102	176	145
Max. ...	80·8	·693	98·0	30·690	10	...										
Min. ...	—37·5	·004	28·0	28·678	0											

On the Thermal Influence of Forests. By ROBERT LOUIS STEVENSON. [Proc. Roy. Soc., Edinburgh.] 8vo.

THE questions raised by Bequerel in his *Climats*, and by the Hon. G. P. Marsh, in *Man and Nature*, are gradually receiving that which they most require, namely, rigorous examination. Dr. Brandis and his fellow-labourers in India, Ebermayer in Bavaria, and many others, are steadily collecting materials far superior to those accessible even to the laborious research of Mr. Marsh, and it is well that it should be so, for the influence of forests and even of cultivation on the climate of localities is a matter of great importance, as we believe our neighbours on the other side of the Atlantic are discovering.

The present paper does not contain any new instrumental observations, but, it is a very calm and clear *résumé* of facts from various quarters bearing on the thermal influence of forests.

Le Variazioni del Vento. Lettura del Prof. DOMENICO RAGONA, Direttore del R. Osservatorio di Modena. Milan: Fratelli Treves, 1874. 8vo.

A HANDY little popular abstract of the directional variations recorded by the Anemometer at Modena Observatory, during the six years, 1867-72.

Prof. Ragona, in accordance with the decision of the Vienna Congress, adopts the English initials for the direction of the winds, but he gives for the convenience of his readers the Italian equivalents, and we for the benefit of our readers, may as well give them also.

N.	Tramontana.	S.	Mezzogiorno.
N.E.	Greco.	S.W.	Libeccio.
E.	Levante.	W.	Ponente.
S.E.	Scirocco.	N.W.	Maestro.

The mode of discussion adopted is, we believe, new, and brings out clearly the relative frequency of direct and retrograde motion, the amount of directional variation at different hours of the day, and with the prevailing wind in various quarters, and the pamphlet is therefore worthy of the attention of all who are charged with the publication of anemometric records.

I Venti Impetuosi. Lettura del Prof. DOMENICO RAGONA, Direttore del R. osservatorio di Modena. Milan: Fratelli Treves, 1874. 8vo.

ALTHOUGH less novel, this is perhaps a more useful paper than the one which we have just noticed. Prof. Ragona starts well by describing in a couple of paragraphs, why strong winds blow. As he puts the matter very clearly, we translate them.

Everything which tends to modify the density of the air, alters the equilibrium of the atmospheric ocean. If at two spots on the earth's surface the density of the air be very different, an atmospheric current will evidently be established between these two regions, in order to restore the equilibrium and, to compensate the defect in one place by the excess from the other. Thus clearly, by the relation

of cause and effect, the greater the departure from equilibrium, the more rapid the resultant current to restore it. The causes which modify the density of the air are many and various. Heat and moisture are the great causes of disturbances of atmospheric equilibrium. The barometer, in short, gives a very good representation of the movements of the air, for if the pressure be unequal at two places a current of air is established between them, and a wind blows from that of greater to that of lesser pressure, and the greater the difference between the barometric readings at the two places, the more rapid will be the current between them.

We cannot follow in equal detail the remaining sixty pages of this pamphlet, but must content ourselves with picking out a few of the more salient points. The Modena anemometer is a velocity instrument recording in kilometres per hour, and it appears that 30 kilos-hour (or 19 English miles-hour *i.e.*, miles per hour), may be regarded as constituting a strong wind at Modena, for winds of that velocity, or above it, only occur about 25 times a year, as is shown by the following abstract:—

Month.	Mean annual frequency of Winds of 19 miles an hour	Mean velocity of High Winds.	Strongest Wind.		Date.		
			Direction.	Velocity.			
		miles hour		miles hour	Y.	D.	H.
January	1·1	22	...	26	1867	31	8P.M.
February	0·9	23	N.	31	72	22	2P.M.
March	4·3	22	S.E.	32	71	29	8A.M.
April	3·9	22	...	32	67	9	11A.M.
May	2·6	21	...	28	67	23	2P.M.
June	1·9	22	S.	33	69	15	10A.M.
July	1·0	20	S.W.	22	71	25	0
August	·9	20	W.	22	72	4	3A.M.
September	1·9	21	S.W.	28	67	20	7P.M.
October	3·1	22	N.E.	31	69	20	11P.M.
November	2·4	23	N.E.	37	71	18	2A.M.
December	1·4	23	S.W.	32	1872	3	6A.M.

We must close with the translation of one or two paragraphs which contain weighty truths too often overlooked.

The values above quoted can only give a feeble idea of the real vel ocity of a strong wind, because the stratum of air level with the anemometer, though 150 ft. above the ground, is greatly retarded by friction against the earth's surface.

And again:—

The values quoted in the above abstracts are the direct result of the observations, but do they correctly record the velocity in kilometres? It would be rash to reply positively in the affirmative. *Each Anemometer has, so to say, its own personal equation.*

We abruptly terminate our quotation with this remark, which is as important as it is true—because there is no lesson which the directors of observatories, both public and private, so much require to be taught, as that at the present time there are scarcely two anemometers in Europe, which are comparable one with another. Prof. Ragona is perfectly right in stating that "Each anemometer has its own personal equation."

Third Report of the Meteorological Office of the Dominion of Canada, for fiscal year ended 30th June, 1873. By G. T. KINGSTON, M.A., Superintendent, 1874. Large 8vo.

THREE years is not nearly a sufficiently long period to determine accurately any meteorological element. Considering, however, the urgent need of approximately correct information respecting the various climates which prevail in different parts of the Dominion, all must agree that Prof. Kingston has done wisely in preparing and publishing four tables of which the headlines are as follows:—

I. Monthly, Quarterly and Annual Means of Temperature
II.* Averages of the Highest Temperature in each month and year
III.* Averages of the Lowest Temperature in each month and year
IV. Monthly, Quarterly and Annual Rainfall, and total Precipitation

} at various places in the Dominion of Canada derived from three or more years.

Prof. Kingston gives the figures, but he gives no comments. We cannot spare space for all the tables, so we jot down a few remarks.

First as to the Monthly Mean Temperature. That of the three winter months, December—February, is remarkably uniform at all stations; January is in almost all cases the coldest month, but only by about 1°. Similarly, the three summer months are very nearly equally warm, July perhaps exceeding June and August by 2° The coldest winter station (mean temp. for January, 10°·2,) is Fitzroy Harbour, Ontario; and the warmest winter station (mean temp. for January, 24°·3,) is Windsor, Ontario. The highest mean monthly summer temperature (July, 72°·8,) occurs also at Windsor, Ontario; and by far the lowest (July, 59°·7,) at St.John's, New Brunswick. The greatest difference between summer and winter is 61°·0 at Fitzroy Harbour, Ontario, and the least at Halifax, 40°·6. The highest mean annual temperature is 47°·3 at Windsor, Ontario, and the lowest is 39°·5 at Bass River, New Brunswick.

The extremes of temperature will not require so much notice. The average absolute max. temp. of each summer, ranges from 79° at St. John's New Brunswick, to 99° at Hamilton, Ontario; over the whole Dominion the shade temperature usually passes 90° each summer, and there are three records exceeding 100°.

There is no Canadian station at which the temperature does not usually fall below zero every winter; the least severity is in Nova Scotia; but even at its warmest station, Glace Bay, the temperature usually falls on one night to —7°·5, and has fallen to —13°·0. This, however, is quite mild compared with Fitzroy Harbour, Ontario, where it usually falls to —38°·0, and has fallen to —41°·0. But even this was, however, once exceeded at Pembroke, Ontario, where the temperature fell to —45°·0.

The mean rainfall varies less than we should have expected, con-

* These tables also give the absolute highest and lowest observed temperatures.

sidering the vast area of the Dominion. Averages are given for 28 stations, viz.—

19 in Ontario,	of which the highest is	40·64 at Simcoe,	lowest 25·20 at Glencoe.
3 in Quebec,	,,	37·54 at Montreal,	,, 31·84 at Quebec.
2 in New Brunswick,	,,	43·12 at St. John's	,, 43·91 at BassRiver
4 in Nova Scotia,	,,	66·00 at Glace Bay	,, 49·23 at Picton.

The mean for Ontario and for Quebec seems to be about 33 inches, for New Brunswick 42 inches, and for Nova Scotia 57 inches.

Although of course we have as usual included *all* precipitation under the general term rain, a moment's reflection will remind everyone that with winter temperatures far below zero, rain is an impossibility. The snow fall in Canada is great, and appears to amount to about 8 feet each year.

In leaving this very useful report, we must not fail to express our earnest hope that Prof. Kingston may in his next contrive to give the tables grouped for the civil year, not as he has hitherto (for what may be considered political reasons only,) done from September of one year, to August of the next. Thereby he renders his mean values absolutely incomparable with those of other systems. We hope that he will try to alter this; and that he will not be thwarted in the attempt.

SUPPLEMENTARY TABLE OF MONTHLY RAINFALL, JANUARY, 1875.

Div.	County.	Station.	Total Fall.
			in.
II.	Kent	Margate (Acol)	2·57
,,	Sussex	Hailsham	2·11
,,	Hampshire	Strathfield Turgiss	3·63
,,	Oxford	Oxford (Magdalen College)	3·62
,,	Essex	Harlow (Sheering Rectory)	2·31
,,	Cambridge	Cambridge (Merton Villa)	2·24
IV.	Norfolk	Swaffham	2·40
V.	Devon	Teignmouth (Brookbank)	5·30
,,	,,	Torrington (Langtree)	8·34
,,	Somerset	Taunton	3·57
VII.	Leicester	Melton Mowbray (Coston Rectory).	2·19
,,	Lincoln	Horncastle (Bucknall)	1·78
VIII.	Lancaster	Liverpool (Walton-on-the-Hill)	3·88
IX.	York	Wakefield (Stanley Vicarage)	3·06
X.	Durham	Gainford	2·38
,,	Westmoreland	Shap	10·90
XVII.	Banff	Keith	2·09
XVIII.	West Ross	Strathconan	7·19
XX.	Cork	Fermoy (Glenville)	9·09
XXI.	Dublin	Kilsallaghan	2·69
,,	Westmeath	Athlone (Twyford)	5·38
XXII.	Galway	Ballinasloe	5·71

RAIN GAUGES.

To the Editor of the Meteorological Magazine.

SIR,—I would be greatly obliged if you or any of your readers would kindly tell me how many ounces of water fall to the inch of rain in a 6-in., 9-in., and 12-in. diameter rain gauge respectively.

I want to graduate a measuring-tube for a rain gauge I am setting up, and, if I am informed on this point, can secure further accuracy by comparing my observations for some time with those from a standard gauge.—I am yours, faithfully,

E. MACDOWEL COSGRAVE.

Reading Rooms, Trinity College, Dublin.

[There is evidently some mysterious charm about making rain gauges, in which we do not share. Over and over again in these pages and in those of *British Rainfall* we have protested against observers making their own rain gauges, and yet we continually find persons doing it. We desire to acquit Mr. Cosgrave entirely of any desire or intention to break rainfall rules; we are certain from the tone of his letter that he has never heard of the objections to such a practice, and to him and to those who like him have not considered the subject, nothing could be more natural than to write such a letter as the above. Indeed, they might well express astonishment that the information which they seek was not reprinted in every issue of *British Rainfall*. Some day, perhaps, we may be compelled to publish as beacons an account of all the home-made gauges which we have tested, but we have no wish to do so. Meanwhile we may briefly sum up our objections. I. Few amateurs have absolute standards of length, hence they cannot be certain of the diameter of the funnels they may employ to 0·001 in. which is expedient, or even to 0·01 in. which is necessary. II. Fewer persons still have accurate measures of capacity; so-called "ounce glasses" often vary considerably, and amateur dividing is rarely either regular or legible. III. It is most desirable to have uniformity in every branch of Meteorology, and this is simply hopeless if people are to make and fit up their own instruments.

We have no wish to withhold information from any one, and we, therefore, append that which is asked for, but we hope that before publishing any results from gauges constructed in accordance with this table, the makers will carefully consider the above objections.

Diameter.	Area.	One inch of water over this area is—		
in.	in.	Grains.	Troy Ounces.	Avoirdupois Ounces.
6 ...	28·274 ...	7140 ...	14·875 ...	16·320
9 ...	63·617 ...	16065 ...	33·469 ...	36·720
12 ...	113·097 ...	28560 ...	59·500 ...	65·280

ED.]

JANUARY, 1875.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1860–5	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Date.	Min. Deg.	Date.	No. of Nights below 32°. In shade	On grass
			inches	inches.	in.								
I.	ENGLAND.	Camden Town	3·22	+ 1·27	·42	1	26	53·8	18	20·7	1	4	7
II.		Maidstone (Linton Park)	3·62	+ 1·56	·63	22	19	56·0	18	12·0	1	4	...
,,		Selborne (The Wakes)	5·10	+ 1·83	·60	1	22	51·0	23*	6·0	1	5	5
III.		Hitchen	2·15	+ ·01	·36	1	21	51·0	18†	22·0	1	5	...
,,		Banbury	2·69	+ ·60	·50	1	21	53·0	18†	15·0	1	6	...
IV.		Bury St. Edmunds (Culford)	2·34	+ ·47	·34	1	15	54·0	19	28·0	21§	6	9
V.		Bridport	4·81	+ 1·62	1·10	1	27	55·0	28	29·0	22	3	..
,,		Barnstaple	5·53	+ 2·01	·73	23	26	57·0	16	27·5	1	...	...
,,		Bodmin	10·52	+ 5·33	1·45	1	30	55·0	14	32·0	22	1	1
VI.		Cirencester	5·30	+ 2·30	·74	24	23	...	...	...	...	...	...
,,		Shifnal (Haughton Hall)	2·46	+ ·56	·46	29	24	54·0	19	20·0	1	5	10
,,		Tenbury (Orleton)	3·16	+ ·63	·53	1	23	55·2	18	17·8	1	5	7
VII.		Leicester (Belmont Villas)	2·97	...	·51	1	21	55·0	14	9·8	1	3	...
,,		Boston	2·03	+ ·32	·38	23	16	55·0	19	14·0	1	4	...
,,		Grimsby (Killingholme)	1·75	...	·28	1	19	52·5	19	6·5	1	4	...
,,		Derby	3·01	+ 1·22	·51	1	22	56·0	31	12·0	1	4	...
VIII.		Manchester	3·57	+ 1·05	·63	1	21	55·0	14	26·5	22	4	10
IX.		York	2·29	+ ·71	...	...	...	...	...	...	...	...	...
,,		Skipton (Arncliffe)	10·78	+ 5·14	1·68	18	30	49·0	18	18·0	1	...	...
X.		North Shields	2·33	+ ·22	·30	3	28	53·8	9	11·2	1	5	12
,,		Borrowdale (Seathwaite)	22·88	+ 6·52	2·28	17	30	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely)	...	...	...	..	...	...	...	...	...	...	...
,,		Haverfordwest	9·70	+ 4·65	1·40	1	30	53·2	19	33·5	21	...	...
,,		Rhayader (Cefnfaes)	...	...	...	...	...	...	...	...	...	...	...
,,		Llandudno	3·03	+ ·49	·41	19	21	61·8	19	25·7	1	1	...
XII.	SCOTLAND.	Dumfries (Crichton Asylum)	7·18	...	·86	4	23	52·6	20	15·0	1	9	12
,,		Hawick (Silverbut Hall)	4·09	...	·90	18	27	...	...	...	...	...	...
XIV.		Kilmarnock (Annanhill)	5·06	...	1·00	18	26	53·0	15	21·8	1	8	14
XV.		Castle Toward	8·13	+ 1·84	·85	20	27	55·0	19	...	...	10	...
XVI.		Leven (Nookton)	4·99	+ 2·12	·54	3	22	53·0	19	12·0	1	14	26
,,		Stirling (Deanston)	...	...	...	...	...	...	...	...	...	...	...
,,		Grandtully	...	...	...	...	...	...	...	...	...	...	...
XVII.		Braemar	4·30	+ 1·17	·67	26	21	50·7	19	17·0	1	12	19
,,		Aberdeen	3·15	...	·45	1	25	53·1	31	15·7	1	10	21
XVIII		Loch Broom	4·49	...	·82	15	23	...	...	...	...	...	..
,,		Portree	8·23	— 4·86	1·06	2	26	...	...	...	...	...	...
,,		Inverness (Culloden)	2·63	+ ·35	...	...	29	52·2	14	15·0	1	13	26
XIX.		Helmsdale	4·42	...	·88	18	23	...	...	...	...	...	...
,,		Sandwick	5·02	+ 1·73	1·14	24	27	48·9	27	24·8	1	7	12
XX.	IRELAND.	Caherciveen Darrynane Abbey	7·36	...	·65	28	26	...	...	...	...	...	...
,,		Cork	7·88	...	·65	12	31	...	...	...	...	...	...
,,		Waterford	7·84	+ 2·98	1·00	14	29	57·0	17	30·0	22	1	...
,,		Killaloe	11·26	+ 6·40	·83	4	30	57·0	28	29·0	6	2	...
XXI.		Portarlington	4·45	+ ·44	·48	18	30	55·0	17	28·0	1	3	...
,,		Monkstown, Dublin	3·60	+ ·21	·36	8	26	...	...	...	...	...	...
XXII.		Galway	5·52	...	·64	2	27	56·0	13‡	31·0	22	2	...
,,		Ballyshannon	4·47	...	·41	1	28	...	...	...	...	...	...
XXIII		Waringstown	4·32	...	·49	4	25	54·0	17	27·0	21	5	12
,,		Edenfel (Omagh)	4·02	...	·44	23	28	52·0	19	26·0	21	8	...

* And 29. † 19. ‡ 15. § 25.

+Shows that the fall was above the average; —that it was below it.

METEOROLOGICAL NOTES ON JANUARY.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; TS for Thunderstorm; R for Rain; H for Hail; S for Snow.

LINTON.—The year commenced with intense frost, but only for a few hours; it then became very mild, and continued so to the end of the month; the ther. falling eight times below 38°, with frosts on 1st, 2nd, 22nd, and 31st. Winds mostly S. and S.W.; very high on the 24th. The R more frequent than heavy; no S; bar. very high on 31st. Between the 25th and 26th, it rose upwards of an inch in 24 hours. On the whole the month has been a remarkably mild one.

SELBORNE.—On 2nd the first thaw in shade for three weeks; 20th, violent wind from W. by S., continuing all night; S on 21st at 4 p.m.; 22nd, bar. rose 0·70 in twelve hours; much wind on 24th and 25th, with heavy H at 9 a.m. and 4 p.m. on 24th, and again on 25th; fog on 28th, 29th, and 30th, and white frost on 31st. The month exceptionally mild for January; productive of rheumatism. The ground, both in fields and gardens, so wet that it could scarcely be worked.

BANBURY.—High wind on 1st, 6th, 14th, 16th, 19th, and 20th.

CULFORD.—The year commenced with mild weather, which still continues. The highest temp. was 54° on the 19th; the lowest 38° on 21st and 25th. The mean temp. of the month was 41°·7, while that of the preceding month (Dec.) was only 30°·5. No S fell during the month; T was heard on the night of 16th, and high winds prevailed on the three following days, and again on the 23rd and 24th; the wind was westerly on 19 days, and easterly on 12 days.

BRIDPORT.—1st, very high floods produced by the very rapid melting of the S (that fell in December), and the heavy R (1·10) of this day; a little S fell on this day. A very wet and miserable month, and particularly noticeable for the great number (27) of days on which R fell. On the 24th a very severe gale from the W. N.W.

BODMIN.—The rainfall this month (10·52) is the highest ever recorded during the past 26 years, except in November, 1852, when 11·01 in. fell. The mean temp. of the month was 48°·1, being 5°·5 above the average.

SHIFNAL.—The severe weather which had lasted through December, and come to a climax on the last night of the year, relaxed on the 1st of January; the min. ther. rising from 14° to 20°, from which day it never fell below 27° throughout the month, nor below 32°, except on five nights. The average max. of the month was 46°, and the average min. 36°. The R, through falling on 24 days, was slight; the heaviest falls being ·40 on 1st, and ·46 on the 29th. The prevailing winds were S. and S.W.; a heavy storm from thence on the 24th; indicated by withstanding the late severe weather. Christmas roses in flower on the 12th; a sudden fall of the bar. that morning. Symptoms of an early spring not-aconites and snowdrops up on 17th; catkins out on the hazels on 21st; and snowdrops fully open on the 28th. Throstle singing from 14th; stockdove first heard on the 23rd. S on the 22nd.

ORLETON.—The frost was severe on the morning of the 1st and was followed by S and R, and a steady thaw at night, which cleared the S off the ground by the 4th, when the rivers overflowed their banks. The weather afterwards was very cloudy, damp, and warm, with frequent slight falls of R; much fog, and very little clear sky. The mean temp. of the month was about 6°·2 above the average, and much higher than that of any month of January for more than 20 years past. On the 24th the bar. fell to 28·70, and on the 30th stood at 30·40 (uncorrected). Violent winds on the 19th and 24th; distant L on the night of the 24th; lunar halo on 22nd; S 3 to 4 in. deep on the 23rd; much R in the night of the 20th and 21st; brooks high on the 21st.

LEICESTER.—Very mild month; only three nights on which the temp. was below 32°. On the night of the 1st R fell, which froze as it fell, coating every thing with ice. General direction of wind during the month S.W.

BOSTON.—Frost broke up with rapid thaw on the 2nd; the min. temp. rising from 16° to 35°. Mean temp. 4°·2 above the average of previous 11 years. Wind S.W. on 21 days; S.E. on 7 days; N.W. on 2 days; and N.E. on 1 day. Very stormy on 19th; windy, with R, on 23rd and 24th.

GRIMSBY.—Min. temp. on 1st 6°·5 ; magnificent rime. Silver thaw on 2nd. A great number of birds starved to death ; redbreasts singing on 12th, and the thrush on 15th. Aconite in flower on 22nd ; crocuses on the 30th ; and hazel catkins shedding their poller on the same day. On the whole a seasonable month.

MANCHESTER.—R and H on the 1st.

NORTH SHIELDS.—Distant lunar halo on 18th ; lunar halo on 22nd ; followed by S.

SEATHWAITE.—Total fall (22·88) on 30 days, on 10 of which it exceeded 1·00 in., on 5 days it exceeded 1·50 in. ; the max. fall being 2·88 in. on 17th.

WALES.

HAVERFORDWEST.—A month of R, gloom, and mildness. Very stormy, with heavy R the first three days ; the ther. never fell to the freezing, nor did the sun appear during the whole month. A great storm of T, L, H, R, and wind, on 24th ; L forked. Extreme depression of bar, being 28·94 (corrected). 25th, very stormy ; the wet weather continued without intermission to the end of the month ; the 7th being the only day on which R was not recorded. The bar. pressure increased in a remarkable manner from the 26th to the 31st ; at 9 a.m. on 30th 30·60, 9 p.m. 30·68 ; at 9 a.m. on 31st 30·50.

LLANDUDNO.—2nd, all the S gone, except on the distant hills. Snowdrops peeping on 4th ; anemones in flower on 6th. Thrush began to sing on 7th, and ceased on the 19th. Snowdrops and crocii in flower on 23rd ; sycamore in leaf-bud on 22nd ; jargonel pear shewing buds on 24th ; mezereum and primroses in flower in the garden on 26th. S on the hills till the 26th ; no frost except on the 1st. Altogether a mild month, and vegetation too forward.

SCOTLAND.

DUMFRIES.—The rainfall this month is nearly double the average for this district, and was brought chiefly by the E. and S.E. winds. S fell on 1st, 20th, 23rd (heavy), and 26th. Strong wind from S.W. on 4th ; wind from W. and N.W. on 18th ; and gale from S.W. on the following day.

HAWICK.—New year's day was a terrible day for snowdrift and wind ; the train which left Hawick for Edinburgh in the morning, stuck in a snow-wreath at Falahill, and many of the passengers had to pass the night in the carriages. The month has been a wet one, which has kept back both farming and gardening operations ; the turnips have suffered severely from the effects of the frosts in December. Hill white with S 20th to 25th inclusive ; 18th and 19th very wet and stormy.

ANNANHILL.—Mean temp. nearly 10° higher than last month ; lowest night temp. on grass 18°, on 1st. Wind principally S.E., S, or S.W. ; usually light to moderate. Strong S.W. gale on the night of the 2nd ; gales on 15th, 19th, and 20th ; on the night of the 18th–19th, strong S. westerly gale, with heavy R, and great flood ; the river Irvine overflowed its banks, and fields were inundated. Sky generally $\frac{3}{4}$ cloud ; several of the nights very dark and foggy ; rainfall in excess ; L on 28th. Death-rate of month 52 per 1000 per annum ; number of deaths 104, the largest number recorded in any month since the Registration Act has been in force ; principal cause of death scarletina.

CASTLE TOWARD.—The month has been wet, cold, and stormy. On the 1st heavy fall of S, but disappearing very soon. On 3rd a heavy gale, on sea and land, from W. and N.W., uprooting many trees ; gale on 19th ; fall of S on 26th thawing as it fell. On the 28th, at 6.50 p.m., loud T in W., followed by L, lasting only a short time. 13th, snowdrops in flower, and the thrush first heard singing.

BRAEMAR.—11th, dense fog all day ; 18th and 19th, L. A month of changeable weather throughout. Severe colds very prevalent.

ABERDEEN.—1st, a terrible gale ; temp. on grass 12°·5 ; bar. below the average ; R and temp. above it. Winds from S., S.W., and W., more frequent than the average ; mean estimated pressure less. A month of mild but foggy weather, with frequent gales.

LOCHBROOM.—The month has been a wonderful mixture of all sorts of weather; frost, S, and R, battling for the ascendancy, in short it has been a very severe month for such as had anything to do with outside feeding or grazing.

CULLODEN.—Rainfall slightly above the average. Aurora on the 8th and 30th; L 19th and 28th; frequent falls of S and sleet, the fall of S on the night of Dec. 31st and Jan. 1st was so great and so drifted by a high wind S.S.E. and S. to S.W. that most of the railways were blocked.

PORTREE.—A cold stormy month; wet, with high winds. S on the 21st, 22nd, and 24th. Heavy gale from S.W. on 3rd, and from S. on the 16th.

SANDWICK.—This was the wettest January that we have had since 1863. On the 1st there was a strong gale of S.E. wind, with snowdrift, and at night a thaw, which soon cleared away the S and frost of December. On the 23rd there was again a formation of snow-rollers, which seems peculiar to our climate, and again there was the combination of circumstances which I formerly stated to be necessary for their formation, viz., 1st, a foundation of a previous fall of S.; 2nd, a recent fall of feathery snow-flakes, with calm weather, and ther. below 32°; 3rd, a strong breeze afterwards, with a ther. above 32°, so as to cause the S to adhere while the wind rolled it up. In this case the wind did not exceed 30 miles an hour, which seemed insufficient for forming rollers, except where it was accumulated at the corners of houses or walls. At the corner of my house, about forty were formed, some of them licking up the gravel and transporting it to the lawn, thus illustrating, on a small scale, the transporting of boulders by icebergs; the largest on this occasion were 14 in. in length, and 12 in. in diameter, like ladies' white muffs; one that measured 11 in. in length and 11 in. in diameter, weighed only 3½ pounds.

IRELAND.

DARRYNANE.—This month chiefly remarkable for the amount of fog and mist; on nine days fog on the low ground, on thirteen other days on the hills, with haze on low lands; winds chiefly S.W., W., and N.W., but on the 10th in p.m. S.E.; also on 11th a.m.; 22nd p.m.; 30th a.m.; E. on 21st; and a.m. on 22nd. H on 1st, 6th, and 24th. L on 6th, 15th, 19th, and 24th; T on 6th and 24th. Frost on 22nd; S on mountains on 21st. Very mild weather, but very unfavorable for agricultural operations; ground soaked with the constant fine R. Gale and heavy sea on 8th; 20th very stormy, with terrific sea; 24th tremendous squalls.

WATERFORD.—22nd to 24th rapid fall of bar from 30·10 to 28·80. The temp. remarkably equable during the month.

MONKSTOWN.—The most noteworthy characteristics of the month are the unusual number of wet days, while the actual depth is small, and the absence of frost, which occurred only on one night, 21st, and that very slight.

BALLYSHANNON.—The month set in cold and wintry, and was wet throughout. Loud T and vivid L at 9.30 on the night of the 16th, with H. The gale of the 19th was the severest which is remembered here since the year 1839, when the church was blown down; although of only two hours' duration, the recent gale will long be remembered for the extraordinary amount of damage which occurred, many roofs were blown off houses, walls tossed, hayricks blown away, and telegraph wires thrown down.

WARINGSTOWN.—Very wet and stormy, tremendous gale for some hours on night of 19th-20th; several large trees blown down here.

EDENFEL OMAGH.—The month was mild and wet, almost without intermission; there was but little frost or S; but about midnight on the 19th this district was visited by the most terrific gale of this century; between 9 and 11.30 p.m. the bar. fell from 29·10 to 28·30, the full force of the storm fortunately only lasted from 11.45 to 12.30 (0·30 a.m. of 20th), but during that time immense damage was done to trees, buildings and farmsteadings. Having made enquiry of those who remember all the circumstances attending the great storm of 6th January, 1839, I am led to the conclusion that this storm was, for the time I have mentioned, of greater violence, and that this district (upon which its full force seems to have been expended) was saved from a great calamity only by the shortness of its duration.

SYMONS'S
MONTHLY
METEOROLOGICAL MAGAZINE.

CX.] MARCH, 1875. [PRICE FOURPENCE, or 5s. per ann. post free.

THE CLIMATE OF SENEGAL.*

WE may introduce to our readers the work noted below as the best on the climate of the West Coast of Africa, with which we are acquainted, and we write this with a goodly pile of similar works on our table, and among them Dr. Horton's capital *Climate and Meteorology of Western Africa*, but he does not appear to have had opportunities for such systematic observations as those now published by Dr. Borius. It must also be recollected that Dr. Horton's work was published in 1867, and that meteorology is progressing at a yearly increasing speed. Lastly, Dr. Borius, as Membre de la Société Météorologique de France, has had good training, and in his preface he expresses his acknowledgmenis for advice and assistance received from M. Ch. Sainte-Claire Deville and from M. Renou. It is not, therefore, remarkable that in W. African meteorology Dr. Borius has left all others far behind.

The French colony of Senegal, or as it is perhaps better known, Senegambia surrounds the intersection of 15° W. longitude and 15° N. latitude, and lies mainly between the rivers Senegal and Gambia. The author divides his work into five sections, namely, the climate of (1) the island of Goree, (2) St. Louis, (3) Dagana, (4) Bakel, and (5) Senegal in general. Each section is very systematically arranged; the topography of the district being given first, then its geology, then a history of the various instruments employed for meteorology, the hours of their observation, the names of the observers and a list of the records which have been preserved; then follows a careful description of the position of the instruments used, and a woodcut which renders the explanation complete.

The author in various sections proves several points connected with temperature, but it appears to us that he occupies unnecessary space in combating the notion that the temperature of Goree is liable to sudden changes. All *prima facie* evidence is in favour of equability of temperature, and when to this is added that of the ten years' observations embodied in this work, we think that Dr. Borius might have contented himself with one or two strongly-worded paragraphs, and have left those who have spread false statements to their own reflections.

* *Recherches sur le Climat du Sénégal.* Par DR. A. BORIUS. Paris: Gauthier-villars, 1875. 8vo, xiv-320 pages, 1 plate.

Goree.—The following table epitomizes some of the most important meteorological elements for the first station, Goree, an island, but almost close to the continent—

Date.	1856—65.	1856—60.			1858—65.	
	Mean Temperature	Mean Pressure 19 ft. above mean sea.	Mean Elastic Force.	Mean Humidity.	Rainfall Amount.	Days.
	°	in.	in.	0—100.	in.	
January	68·5	29·886	·585	83	·01	
February.....	66·0	·863	·549	83	·07	
March	68·0	·823	·571	81	...	1
April	68·9	·815	·622	85	·01	
May	71·6	·831	·714	86	·01	
June	78·3	·835	·891	86	·84	1
July..	81·3	·823	·955	87	4·05	6
August.....	81·5	·808	·961	87	10·92	14
September ...	82·2	·812	·988	89	4·68	9
October	82·0	·804	·999	87	·28	1
November ...	78·1	·815	·867	85	·10	1
December.....	71·6	29·863	·611	77	·01	
Mean	74·8	29·831	·776	85	20·95	33

Highest shade temperature, October 11th, 1861..... 91·4
Lowest ,, ,, January 28th, 1859..... 57·2

With respect to the rainfall, only two notes are necessary; (1) that the gauge was on a roof about 19 ft. above the ground and that therefore the true fall at Goree is rather larger than that stated above, and (2) that Dr. Borius says that the floods in the river Senegal are such as to prove that the rainfall must be much heavier in the interior. He incidentally quotes the mean rainfall (1846–50) at Cayenne, 138·32, and at Madagascar 104·18.

The tension of vapour and humidity are considered by Dr. Borius to be rather too high, but no better data exist. The amount of cloud is not recorded in the usual way, but it is evidently small, for in a typical year 1860, the sky was at 6 a.m. and 4 p.m. absolutely free from cloud on 99 and 134 occasions respectively. This cloudless sky is, however, by no means an advantage, for it allows the vertical sun to exert its full force. The author's description of the noon-day heat of Central Africa seems so calmly truthful that we translate a few paragraphs.

"In the *dry season*, the fine season, our journal only records 15 overcast days, while there are 68 with light clouds, and 100 absolutely cloudless. It is especially in March, April, and May that the sun darts his pitiless rays for 12 or 13 hours on the soil, which is scorched and destitute of all traces of vegetation. On the coast, thanks to the neighbourhood of the sea, this solar radiation is happily bearable and the heat is only painful to those who are obliged to expose themselves. But in the interior, at Bakel for instance, the effect of the sun is very great. Then is it that the dessicated earth can support no active vegetation, that in the

middle of the day even the natives cannot walk barefoot on the burning sands, but are compelled to seek refuge in their huts. Animals of all descriptions, both wild and tame, shun it equally and seek any shelter from its rays.

"When this star shines from near the zenith, silence spreads over nature; the birds cease their song and go to sleep, except a few powerful eagles which soar upwards to the cooler strata of high altitudes, where, almost lost to sight, they hover in silent solitude.

"The siesta is not a need for man alone, most animals take it in these climates, nor is it peculiar to Senegal, for it prevails throughout all tropical regions. Nothing equals the majestic silence of the immense forests of equatorial Africa, when the sun is in the zenith of its power. Even the insects appear to partake of the general repose of nature, the sound of them no longer guides the researches of entomologists, who at this time can only find them under the shelter of leaves. This general state of all living creatures is not ordinary sleep, a special word is necessary to designate it."

It is merely necessary to add a word or two calling attention to the very heavy dew which prevails during the evening and night hours, and which is so copious as to damp the clothes of those who are so unwise as to expose themselves unnecessarily to its influence.

St. Louis.—This is the capital of the French possessions on the African coast, and with its suburbs contains a population of 15,700 persons; it is built on two islands, or more properly on two sand banks, in the river Senegal, and is so little elevated above the sea that it was frequently inundated, until the floods were excluded by strongly built quays. In addition to a long series of observations made by various resident medical officers (and of which records nine-tenths appear to be lost), a set of observations were made by the author during 1873 and 1874. He was furnished with a complete set of the ordinary meteorological instruments, and placed them upon a stand of the usual French pattern. He also employed the *thermomètre fronde*, and as his remarks upon mean temperature have a more than local interest and application, we reproduce them.

MEAN TEMPERATURE.

"What is the relative value of the various methods adopted for the determination of the temperature of a country, and which shall we select as the true mean temperature of St. Louis? Let us first examine the two series of observations—those from the shade thermometer and those from the *thermomètre-fronde* used in the shade with due attention to the precautions recommended.

"The differences between the two means are between 0°·4 and 0°·9 in the dry season, and between 0°·2 and 0°·4 in the winter. The mean yearly difference is 0°·4, the *thermomètre-fronde* being always the higher, whereas, in France it is usually lower than the shade thermometer.

"Are we hence justified in assuming that the difference between the two thermometers is at Senegal always in the opposite direction to that in the temperate zone?

"If the *thermomètre-fronde* has given us results slightly too high, we think that in observing this instrument in a garden, above a turfed

surface, we should have obtained, as in France, a mean lower than that indicated on the thermometer stand.

"This impression is justified by a note which the talented director of the observatory of Saint-Maur (Paris), has had the kindness to send to us, with permission to insert it in this work. We recommend the perusal of this note to our naval colleagues, who will thereby learn to avoid useless observations, and how to make good ones both on board ship and in our colonies. The high scientific standing of M. Renou, gives special importance to his remarks.

NOTE ON THE DETERMINATION OF THE TEMPERATURE OF THE AIR.
By M. E. RENOU.

"The observation of the temperature of the air, by means of a fixed thermometer, is generally very inaccurate, at least, when one has not a suitable thermometer stand, placed over grass, in a sufficiently open space, the values obtained will differ from the true temperature of the air.

"The *thermomètre-fronde* was arranged in order to overcome this difficulty; it merely consists of a light mercurial thermometer graduated on the stem, which is swung round in the shade by a string 2 ft. long, with a speed of about eight revolutions per second."

[Radius being 2 ft., the circumference is 12½ ft., and therefore the velocity quoted above is 100 ft. per second, or, more than a mile a minute. We find it difficult to count such rapid revolutions, and cannot satisfy ourselves that eight revolutions per second can be obtained without mechanical arrangements, however, four revolutions are probably as good as eight, and four are both obtainable and countable.—ED. M. M.]

"In order to make an observation, the observer should so place himself in the shade of some small object, that the wind either meets him full in the front, or completely on one side, the object being to prevent the air which acts upon the thermometer from having been previously affected by the observer's body. It will generally be found that the value thus obtained is less than that given by the fixed thermometer. When there is much reflected light, it is not unusual to find the *thermomètre-fronde* in full sun lower than that in the shade, and which is supposed to give the true temperature of the air."

"Persons not conversant with physics may fancy that the wind lowers the temperature of the *thermomètre-fronde* below that of the air, but that is only the case when the thermometer is damp, a source of error against which it is always necessary carefully to guard. A dry thermometer thus treated *develops heat*, but only to an unappreciable extent."

"It is unnecessary to use the *thermomètre-fronde* in addition to the ordinary instrument on the stand; slight differences will be found, but they neutralise one another in the yearly means. But it is very interesting occasionally to compare the fixed instrument with simultaneous observations of the *thermomètre-fronde* made in the nearest exposed place, in the full sweep of the wind and in the shade of a single isolated object like the trunk of a tree."

"No ordinary place of observation can be considered as proved to be satisfactory until its records have been submitted to this test at all seasons and at all observation hours."

"On board ship, the *thermomètre-fronde* will alone give good results, thermometers fixed to the masts are not only exposed to reflection, but both by changes in the position of the sun in its daily course, and by the variation in the direction of the ship's head, are continually liable to exposure to the direct rays of the sun."

The author then returns to his subject, and decides that the mean temperature of St. Louis is 73°·8 or 1°·0 lower than Goree; the extremes are, however, greater, being 101°·8 and 48°·6 respectively, the maximum of 101°·8 on April 2, 1874, io undoubtedly correct, being confirmed by the shade reading at 1 p.m., of 99°·9 and *thermomètre-fronde* of 100°·6.

The rainfall of St. Louis is very small, very variable in amount, and nearly all falls in July (2·24), August (9·69), and September (2·91), August alone having upwards of 60 per cent. of the yearly total. During the following eight years no rain fell in April or December, and the yearly totals were—

1861.....	11·54 in.	1868.....	11·97 in.
1862.....	21·97	1869.....	25·55
1863.....	5·55	1870.....	16·06
1864.....	15·87	1873..	14·12

For three years simultaneous observations were made at Goree and St. Louis, with the following results—

	Goree.		St. Louis.		Goree = 100 St. Louis =
	in.		in.		
1861.....	14·69	.....	11·54	.....	78
1862..... ..	23·62	.....	21·97	.....	93
1863.....	18·31	.....	5·55	.....	30

As to the rainfall of the interior no useful records exist.

Dr. Borius made a set of observations (with Pichè's evaporator) for twelve months, the total amount indicated being 78 inches.

The mean pressure of St. Louis cannot differ materially from that at Goree; the mean of 12 months' observations (6, 10, 1, 4, 9) by Dr. Borius, reduced to 32° but not corrected for instrumental error, was 29·894 at 15 ft. above sea, say 29·91 at sea level. Three years' observations, made previously at the same hours, gave 29·29, correcting the value in the table on page 18 for elevation, it gives for Goree 29·85, it therefore seems probable that the true pressure in that district is within a few hundredths of 29·90.

Before leaving the subject of pressure, we may compare the values here given, with those deducible from the isobars of Buchan and Wojeikow—

		Dr. Borius.			Buchan.	Wojeikow.
	Goree.	St. Louis.	Mean.			
	in.	in,	in.		in.	in.
January .....29·904	...	29·941	... 29·92	...	29·98	... 30·04
July..... . 29·841	...	29·917	... 29·88	...	30·08	... 29·96
Year .....29·85	...	29·92	... 29·89	...	29·96	... —

Dagana.—Very few observations have been made at this town, which is about 75 miles inland, on the bank of the Senegal, a good thermometric series, however, were taken (6 a.m., 2 p.m., 9 p.m.) by the author in 1862, which give the mean temperature as 78°·4, the maximum as 105°·8, and the minimum 55°·4.

Bakel.—The observations at this station, which is about 320 miles inland, are unfortunately very incomplete, but although Bakel is at a considerable elevation, its distance from the sea renders it extremely hot, Dr. Borius assigns for its mean annual temperature 83°·7, and for its maxima and minima, respectively, 110°·5, and 58°·3. Questions often arise as to the temperature of the soil in tropical climates—the following is in this respect interesting.

"According to a note accompanying the observations of M. Verdier in 1872, when the shade temperature was 107°·1, a thermometer carried in the sun was 113°, and placed upon the sand it went up to 142°."

Our readers will infer from the space which we have devoted to it, that we have a high opinion of Dr. Borius's work. It is rare that men of his standing reside so long in such a climate, one which during its wet season can only be described as deadly; it is rarer still that while there they display the energy that he did; but it is rarest of all, nay unprecedented, for them to return as he has done to pleasant France, and give to the world a meteorological work of which any one might be proud to be the author.

REVIEWS.

Relation between the Barometric Gradient and the Velocity of the Wind. By W. FERREL, A.M., Assistant United States' Coast Survey.

As this important paper has only been printed in the *American Journal of Science and Arts*, for Nov., 1874, and will have a limited circulation among British readers, we purpose to give here rather a *resumé* of it than a review.

"Let G = the barometric gradient in the direction in which it is the steepest, estimated by the amount of change in the mercurial column in the distance of 100 miles;

v = the velocity of the wind in miles per hour;

r = the radius of curvature of the isobar or line of equal barometric pressure;

i = the inclination of the direction of the wind to the isobar on the side of lowest pressure?

n = the earth's hourly angular velocity of rotation in terms of the radius;

l = the latitude of the place;

P = the barometric pressure of the atmosphere;

P′ = the value of P at the earth's surface.

The following equation then expresses very nearly the relation in all cases between the barometric gradient and the velocity of the wind :—

(1), $G = \frac{(2\,n.\,\sin l + u)\,v.\,\sec i}{8300000} \cdot \frac{P}{P'} = \frac{(\cdot 524 \sin l + u)\,v.\,\sec i}{8300000} \cdot \frac{P}{P'}$ in which

(2), $u = \frac{v.\,\cos i}{r}$."

This law embodies principles which the author states that he has published at different times and places, but he does not give the references to them. On this ground, he excuses a demonstration as too complex and mathematical, and proceeds to give an explanation instead, which he bases upon the law of centrifugal force. He claims for the law as much importance in meteorology, as far as the barometric pressures and the velocities of the winds are concerned, as Kepler's laws were in astronomy, as it must hold good for all latitudes from the equator to the poles, both at sea and on land, and for all altitudes from the earth's surface even beyond the region of the cirrus cloud. He explains that the law accounts for the trade winds and anti-trades, and for the calm belts. "The barometric pressures given by Professor Loomis (Meteorology p. 18) indicate that at about the parallel of 64° N. and about the parallel of 74° S., there is a minimum of barometric pressure, and hence G vanishes in these latitudes, and therefore, for reasons which have already been given, we must have calm belts there." This is the first we ever heard of these calm belts.

We agree that "the real velocities and directions of the mean constant winds have been determined only very roughly from observation on any part of the globe, and hence no very accurate comparisons of our law with observations can be made. Such comparisons, however, all seem to establish the truth of the law within the limits of the errors of observations"; and also, that "the law can only be tested by comparing the average velocity of a great many individual cases with the average of the corresponding gradients, as deduced from the isobars, taking account of the distances of the stations from the centres of curvatures of the isobars." Nevertheless, he proceeds to show how it applies to cyclones; how it accounts for areas of high barometer as well as low, with their calms, and for the force of winds in cyclones at sea exceeding that on land.

He proves by figures indeed too much, for he "shows that the velocity of the wind belonging to the same gradient diminishes considerably towards the centre of the cyclone," overlooking the fact that the gradients always become steeper towards the centre, and are therefore accompanied by stronger winds.

Against several other assertions, not proven might be pleaded, and some might be denied altogether. Thus, where shall we find proof that "in a perfect cyclone the isobars are circular;" that there is a motion "towards the centre below, and from the centre above, in an ordinary cyclone, giving rise to a spiral motion;" that "in order to keep up the motive power of the cyclone, there must be difference of temperature between the internal and external parts." (?) These

statements may be shown to suit the formula, but we cannot accept that as a proof of their being facts.

"The value of i depends upon friction, and its value can only be determined from observation."

"For all ordinary winds it is probable that the value of i is nearly constant for all velocities, and, if so, being once determined from observation for a given kind of surface, as that of the sea, or of any kind of land surface, as that of a prairie, this value is probably applicable to cyclones of all degrees of violence upon such surface except near the centre, and may be regarded as a known and fixed constant for that kind of surface." Here, however, he overlooks that i varies with the latitude, for he elsewhere shows that the greater the latitude the less must be the value of i, and at the equator $i=90°$. We know of no observations which establish it as a fact that $i=90°$ at the equator; indeed, they seem to prove it to be considerably less, nearer 60°.

Mr. Ley obtained for the average of fifteen stations in the British Isles, corresponding to the mean parallel of 55° N., $i=21°$. Professor Loomis, for the United States, mean latitude 40° N., $i=45°$.

The mean constant isobars in the British Islands, as determined by Mr. Glaisher, all effects of the seasons and of local disturbing causes being eliminated, give very nearly $G=\cdot02$ of an inch. With this value, supposing the direction of the wind to be towards the east, or nearly so, so that the value of i is small, we get $v=6$ miles nearly." The law therefore applies very fairly here. "The value of i, except at internal stations where the resistances are great, may be regarded as so small that its secant can be taken as unity, and hence either the gradient or the velocity of the wind is known the one from the other. For inland stations where the resistances are great, the value of i must be obtained from observation."

"Mr Ley likewise obtained the very important result that the difference between the inclination of strong and light winds at stations on the coast is trivial, but at inland stations the mean inclination is less with strong than with light winds, and that at all stations the inclination is more regular with a gale than with light winds. This is all exactly in accordance with the preceding theory, for where the value of u becomes large, as it does near the centre of a cyclone, the value of i must become less."

Referring to the *Quarterly Journal of the Meteorological Society*, 1874, July, we find in the month of December, on the 50th parallel, in the Indian Ocean, $G=\cdot046$, mean direction of the wind N. 60 W., 21 miles per hour. Now, for such a wind, in this latitude, the theoretical value of G is ·075, which we see is greater than the observed.

The difficulty in testing the formula by individual cases, lies in ascertaining, with any approach to correctness, the radius of curvature of the isobar. Let us take Toynbee's synoptic chart for 1870, Feb. 5th, 8 A.M., Greenwich time. Here, in lat. 45° N., long. 25° W., we

take as nearly as possible $r = 350$ miles, $G = \cdot 114$ inch per 100 miles, $i = 45°$, force of wind 9 = 56 miles velocity. For this wind the theoretical gradient is 0·3 nearly, which again is larger than the observed.

Again, Toynbee's chart for January, Sq. 3. in lat, 8° N., long 30° W., gives $G = \cdot 01$, wind N.E. about 20 miles per hour, $i = 45°$. Here the theoretical value of G comes out ·027, which is more than double the actual value.

On the whole, therefore, it may be said that the formula does not completely represent the facts, though probably it may eventually be modified to do so.

By integration of the formula, Mr. Ferrel gets an expression for estimating barometric depressions and he says, "up to this time no meteorologist has accounted for these depressions." Moreover, he claims that this expression accounts for the extremely small barometric oscillations at the equator other than the diurnal range, "where cyclones cannot be formed;" and also for the increase of the mean monthly ranges of the oscillations of the barometer with the latitude.

We have had quite enough to show that Mr. Ferrel's law, if not perfect, is approximative, and takes within its scope a vast range of phenomena. We believe that he is in the right path with his mathematics, and hope that he will keep working upon the subject until he renders his formula more adapted to represent the actualities. For one thing it may be remarked, that the isobars are generally at unequal distances apart, and hence gradients do not apply over a great distance; it would then, apparently, be better to limit the gradient to 60 nautical miles, or one degree of latitude.

R. STRACHAN.

Sur les Observations Pluviométriques faites dans le Sud-ouest de la France surtout de 1861 *à* 1870. Par V. RAULIN. 8vo. 327 pp.

WE have, on several occasions* called attention to the large quantity of good rainfall work done for the South-West of France by Prof. Raulin. We rejoice to learn that it is probable that it will finally assume much larger dimensions than was originally contemplated even by the Professor himself. The introduction to the above set of tables is very short, and gives such a clear account of the present state of the work, and of its prospects, that a translation will be generally interesting:—

"The work previously inserted in the *Actes de l'Académie de Bordeaux*, 1863 and 1864, contains the various series of observations from 1714 to 1860, made in the South-West of France.

"Subsequently, many other series made in the seven Departments have come to my knowledge, and the decade 1861—1870 has been completed, during which also (especially in 1869 and 1870) new stations have been established.

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* *Meteorological Magazine*, vol. I. p. 83; II. p. 71; IV. p. 195; V. pp. 33, 50, 68, 95; VI. p. 86.

"Enlarging the scope of my original work, I have collected the observations made both in the Central Plateau of France, and in the S.E. which joins on to those of Southern Languedoc. Thus I now possess the rainfall observations made throughout the southern half of France, south of a line drawn from Noirmontiers [on the west coast, Lat. 47° N.] through Moulins to Lyons and Geneva. In addition to which I have collected those made in Corsica, in Algeria, and those in the various French colonies in the tropics.

"I have thought that it would be very interesting to publish all these observations uniformly with those previously printed. This opinion having been shared by the Committee of the Learned Societies (Science section), the Minister of Public Instruction has had the kindness to authorise a grant for their publication in the same collection as the previous series.*

"This new work will therefore be divided into seven parts:—

I.—The remainder of the observations made in the S.W. of France.

II.—Observations made in the Central Plateau of France.

III.—Observations made in the S.E. of France.

IV.—Comparisons and deductions from the Observations made in the Southern half of France.

V.—Observations made in Corsica.

VI.—Observations made in Algeria.

VII.—Observations made in French Tropical Colonies.

"The remainder of the observations made in the South-West will be published in exactly the same order as the previous portion, except that the *Appendice intercalaire* of Chapter II.: Aquitaine toulousaine, which includes the Departments of la Corrèze, le Cantal, la Lozère, and l'Aveyron will be transferred to the Central Plateau of which it forms the southern portion.

"I give previously, for each year from 1861 to 1870, comparative tables of the rainfall observations which show, month by month and season by season, the agreements and differences which exist between the amounts collected at the various stations in the same towns or departments, and throughout the South West of France."

Professor Raulin has sketched the outline of a grand work, for which future generations of agriculturists, engineers, and physicists, will indeed be thankful. May he have health, strength, and ample support to enable him to complete it!

Results of an Examination of the United States War Maps for 1872 *and* 1873. By PROF. E. LOOMIS. First and Second Papers. [From *American Journal Science and Art*, 1874.] 8vo., 15 and 14 pages, 3 plates.

IF the Americans do not learn how to make accurate weather-forecasts,

* A little later, when the observations made in Northern France have been collected, I hope it will be possible to publish them also, and thereby to complete the publication of all the rainfall observations made in France and in its various colonies.

or fail to unravel completely the laws which regulate the path of storms, we shall be surprised. They have everything in their favour, the government has placed a large staff and ample funds at the disposal of General Myers, and all his efforts appear to be devoted to these two practical problems. Moreover, both by its extent and by its broad features of physical geography, America is specially adapted as a field for such studies, perhaps unequalled on the globe. And though last, by no means least, there are many men in the States eminently fitted for turning to the best account the copious information published, and liberally circulated, by General Myers.

The two papers above mentioned, though short, are very practical, and afford evidence of the mutual interdependency of several meteorological phenomena, which had previously been "supposed," or "presumed," or assumed to exist, but of which absolute proof had not been forthcoming, while we believe that a few relations are stated for the first time. This is a great gain, and we cordially acknowledge the value of Prof. Loomis's deductions. As it is impossible for us to discuss all the points raised, we think that the best plan will be merely to state the subjects of some of the various sections into which Prof. Loomis has divided his papers. They are as follows:—(1) mean direction, and velocity of translation across America of storm centres in each month of the year; (2) influence of rainfall upon the course of storms; (3) influence of the wind's velocity upon the progress of storms; (4) does the velocity of a storm's progress depend upon the rate at which the barometer falls when the storm is approaching, or upon the rate at which it rises when the storm has passed? (5) to determine whether a storm is increasing, or diminishing in intensity; (6) form of the isobaric curves; (7) where do the storms which seem to come from the far west originate? (8) direction and velocity of wind within areas of maximum pressure; (9) consequences of the outward flow of air from an area of high barometer; (10) monthly minima of temperature; (11) long continued periods of cold weather; (12) connection between the velocity of the wind and the distance between the isobars, in the neighbourhood of a storm centre.

These heads are sufficient to indicate the extreme importance of Prof. Loomis's papers, and the rich harvest which a clear-headed and able man can gather from the United States Weather Maps.

SUPPLEMENTARY TABLE OF MONTHLY RAINFALL, FEBRUARY, 1875.

TRUE to our motto, "Deeds, not words," we sound no flourish of trumpets respecting the following table, and willingly undertake the trouble of its monthly compilation, confident that in the approbation of our readers we shall find our (probably sole) reward. There is, however, one feature to which, if we do not call attention, sufficient weight will not be attached, and we have, therefore, no alternative. Happily, the days when a mere array of names and figures was

assumed to be valuable have passed away. Readers are beginning to realize that it is positively injurious for figures to be numerous, unless they are correct; and that a few judiciously disposed stations are more useful than a large number irregularly distributed. It will be noticed that in order to render the year complete, we have reprinted the values for January.

Station.	County.	Div.	Lat.	Lon.	Total Rain in Jan.	Feb.
					in.	in.
Acol	Kent	II.	51 21 N.	1 19 E.	2·57	0·81
Hailsham	Sussex	,,	50 52	0 16 E.	2·11	1·23
Strathfield Turgiss	Hampshire	,,	51 20	1 0 W.	3·63	2·29
Addington	Bucks.	III.	51 57	0 55	3·28	1·18
Oxford	Oxford	,,	51 45	1 15 W.	3·42	1·63
Cambridge	Cambridge	,,	52 13	0 8 E.	2·24	0·83
Sheering	Essex	IV.	51 48	0 11	2·31	0·71
Ipswich	Suffolk	,,	52 4	1 9	1·83	0·96
Diss	Norfolk	,,	52 22	1 7	2·12	1·22
Swaffham	,,	,,	52 39	0 42 E.	2·40	1·40
Compton Bassett	Wilts	V.	51 27	1 56 W.	5·46	2·12
Hessary Tor, Dartmoor.	Devon	,,	50 33	4 0	19·75	4·85
Teignmouth	,,	,,	50 32	3 30	5·30	1·93
Torrington	,,	,,	50 55	4 11	8·34	1·75
Falmouth	Cornwall	,,	50 9	5 4	6·29	
Taunton	Somerset	,,	51 1	3 6	3·57	2·29
Cheadle	Stafford	VI.	52 58	1 57	3·49	1·39
Ashby de la Zouch	Leicester	VII.	52 45	1 27	5·06	1·08
Coston, Melton Mowbray	,,	,,	52 48	0 45	2·19	1·45
Bucknall	Lincoln	,,	53 13	0 15	1·78	0·94
Mansfield	Nottingham	,,	53 9	1 12	3·38	1·90
Walton, near Liverpool.	Lancaster	VIII.	53 30	2 68	3·88	1·11
Broughton-in-Furness	,,	,,	54 17	3 12	7·95	2·03
Stanley, Wakefield	Yorkshire	IX.	53 43	1 28	3·06	1·22
Gainford	Durham	X.	54 32	1 44	2·36	1·21
Shap	Westmoreland.	,,	54 31	2 41	10·90	1·59
Llanfrechfa	Monmouth	XI.	51 38	2 58	8·32	2·07
Castle Malgwyn	Pembroke	,,	52 3	4 35	7·26	1·68
Heyhope	Radnor	,,	52 23	0 37	5·24	
Melrose	Roxburgh	XII.	55 37	2 48	3·76	1·49
Cessnock, Glasgow	Lanark	XIV.	55 51	4 17	6·70	1·55
Gruinart	Argyll	XV.	55 49	6 20	6·33	1·90
Keith	Banff	XVII.	57 35	2 53	2·09	1·01
Strathconan	West Ross	XVIII.	57 34	4 48	7·19	1·68
Tain, Springfield	East Ross	,,	57 49	4 4	3·70	0·74
Skibbereen	Cork	XX.	51 33	9 16	5·92	2·39
Fermoy	,,	,,	52 3	8 27	9·09	1·86
Kilrush	Clare	,,	52 37	9 29	4·15	0·98
Kilkenny	Kilkenny	XXI.	52 40	7 15	4·33	1·27
Kilsallaghan	Dublin	,,	53 27	6 17	2·69	2·10
Twyford, Athlone	Westmeath	,,	53 26	7 50	5·38	1·46
Ballinasloe	Galway	XXII.	53 19	8 15	5·71	0·90
Kylemore	,,	,,	53 33	9 52	10·80	2·93
Bangor	Mayo	,,	54 8	9 43	5·73	1·89
Carrick-on-Shannon	Leitrim	,,	53 56	8 5	4·55	1·38
Warrenpoint	Down	XXIII.	54 44	6 15	4·83	2·57
Bushmills	Antrim	,,	55 13 N.	6 31 W.	3·15	1·26

ENGLISH AND AUSTRALIAN SEASONS.

To the Editor of the Meteorological Magazine.

SIR,—The query contained in the accompanying letter, I am unable to answer. Can you afford me any solution of the matter, or would you kindly publish the letter in extenso in your columns to provoke enquiry and ventilate the question.

Very faithfully, yours,

C. H. GRIFFITH, F.M.S.

Strathfield Turgiss, March 3rd. 1875.

The Vicarage, Mortimer West End, Reading, Feb. 23, 1875.

DEAR SIR,—As you are much interested in Climatology I write to bring under your notice a matter which you might like to know of, unless (as is very probable) you are already acquainted with it.

When Archdeacon Harper was in England, eight or nine years ago, he told me that he had compared the seasons for the four previous years, and had found that the general character of *our* season followed that which had preceded it at the Antipodes. He had not thought of making any comparison before the date mentioned. So limited a range of observation could of course *prove* nothing. Since I met Harper, I have remarked that the statements in the newspapers about the Australian seasons have been similar to what has followed here. Last summer I read in the *Times* that they were finishing the severest winter known in those colonies, and we certainly have got a long and severe season now.

If this supposed similarity of the seasons is new to you, I think you might find it worth while to compare the records of Australian seasons with ours to see whether (as a general rule) we follow their lead. If it should prove to be the case, it would be a most useful point to establish.—Believe me, yours very truly,

REV. C. H. GRIFFITH. A. L. WHITE.

P.S..—I have only *occasionally* had an opportunity of comparing our seasons with those at the Antipodes.

[This very important question can only be answered after considerable research. Absolutely unassailable (and hitherto unattainable) facilities for its investigation are now regularly published in our cotemporary "The Colonies," whose last table, August, 1874, gave returns from

England	Ceylon	Falkland Isles
Cape of Good Hope	Queensland	Barbados
Mauritius	N. South Wales	Honduras
Calcutta	Victoria	Canada
Bombay	Tasmania	Newfoundland
Madras	New Zealand	British Columbia

We recommend careful examination of these tables, and with reference to previous years are quite ready to help (by the loan of copies of Australasian returns) any one who will tackle the question, but we really cannot promise to undertake it ourselves.—ED.]

FEBRUARY, 1875.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1860–5	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Date.	Min. Deg.	Date.	No. of Nights below 32° In shade	On grass
			inches	inches.	in.								
I.	ENGLAND.	Camden Town	1·06	— ·16	·36	11	16	51·2	14	25·1	24	19	24
II.		Maidstone (Linton Park)	·93	— ·58	·19	25	10	55·0	15	21·0	6, 24	23	...
,,		Selborne (The Wakes)	2·20	+ ·49	·56	6	11	49·5	14	21·0	9	19	24
III.		Hitchen	1·05	— ·21	·27	11	10	45·0	1, 15	20·0	23	26	...
,,		Banbury	·96	— ·47	·15	20*	15	53·0	14	23·0	6	25	..
IV.		Bury St. Edmunds (Culford)	1·21	— ·21	·40	11	12	51·0	14	17·0	23	23	25
V.		Bridport	2·30	+ ·24	·80	6	9	55·0	13	25·0	5, 11	22	...
,,		Barnstaple	1·79	— ·29	·70	6	8	53·0	14†	30·0	6‖	..	...
,,		Bodmin	1·65	— 1·14	·62	11	11	53·0	14	27·0	23	8	11
VI.		Cirencester	2·56	+ ·95	·68	6	10	...	...	...	...	...	...
,,		Shifnal (Haughton Hall)	1·56	+ ·67	·57	20	·12	50·0	1‡	23·0	5, 6	19	23
,,		Tenbury (Orleton)	2·14	+ ·57	·37	25	13	54·5	14	24·3	6	19	21
VII.		Leicester (Belmont Villas)	1·09	...	·31	11	14	55·0	14	26·0	22	18	...
,,		Boston	1·69	+ ·48	·40	20	12	53·0	14	27·0	6, 7	19	...
,,		Grimsby (Killingholme)	1·01	...	·30	24	13	52·0	14	25·0	6	11	...
,,		Derby	...	...	...	...	...	...	...	...	...	...	..
VIII.		Manchester	·74	— 1·21	·16	11	10	52·0	14	23·0	5	13	21
IX.		York	1·20	— ·18	·26	11	11	50·0	14	22·0	6	17	...
,,		Skipton (Arncliffe)	1·92	— 1·75	·57	11	14	46·0	13	20·0	3	11	...
X.		North Shields	1·21	— ·32	·16	24	19	52·0	1	27·4	6	13	17
,,		Borrowdale (Seathwaite)	...	...	...	...	...	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely)	...	...	...	...	...	...	...	...	...	...	...
,,		Haverfordwest	2·80	— ·06	1·14	6	10	52·5	12	24·0	23	15	21
,,		Rhayader (Cefnfaes)	...	...	...	...	...	...	...	...	...	...	...
,,		Llandudno	2·14	+ ·79	·44	20	16	55·5	13	29·5	10	9	...
XII.	SCOTLAND.	Dumfries (Crichton Asylum)	1·18	— 1·37	·26	13	10	50·7	15	21·0	5	22	25
,,		Hawick (Silverbut Hall)	1·07	...	·23	13	15	...	...	...	...	...	..
XIV.		Kilmarnock (Annanhill)	1·32	...	·49	13	9	52·3	14	24·0	4	13	17
XV.		Castle Toward	1·50	— 2·24	·45	12	7	52·0	14§	...	...	17	...
XVI.		Leven (Nookton)	1·86	+ ·16	·45	24	14	54·0	16	20·0	5	20	26
,,		Stirling (Deanston)	...	...	...	...	...	...	...	...	...	...	...
,,		Grandtully	...	...	...	...	...	...	...	...	...	...	...
XVII.		Braemar	·81	— 1·17	·20	13	14	48·9	1	11·0	5	20	25
,,		Aberdeen	1·74	...	·48	7	15	52·1	14	18·8	6	8	22
XVIII		Loch Broom	...	...	...	...	...	...	...	...	...	.	...
,,		Portree	3·20	— 7·03	1·05	13	13	...	...	...	...	...	...
,,		Inverness (Culloden)	·71	— 1·17	...	...	14	50·1	13	22·0	6	16	25
XIX.		Helmsdale	1·97	...	·46	7	19	...	...	...	...	...	...
,,		Sandwick	1·99	— ·49	·42	11	20	48·0	1	28·0	24	7	14
XX.	IRELAND.	Caherciveen Darrynane Abbey	2·48	...	·50	11	13	...	...	...	...	...	...
,,		Cork	1·41	...	·33	3	17	...	...	...	...	...	...
,,		Waterford	...	...	...	...	...	...	...	...	...	..	...
,,		Killaloe	1·75	— 1·15	·40	11	16	...	...	26·0	23	...	...
XXI.		Portarlington	1·78	— ·25	·38	21	21	53·0	13	27·5	3	14	...
,,		Monkstown, Dublin	2·52	+ ·88	·67	20	16	...	..	...	...	..	...
XXII		Galway	1·04	...	·33	12	10	53·0	1, 2†	27·0	23	7	...
,,		Ballyshannon	1·41	...	·60	13	14	...	...	...	..	...	...
XXIII		Waringstown	...	...	...	..	...	...	..	...	..	...	...
,,		Edenfel (Omagh)	1·23	...	·47	13	12	50·0	13	21·0	3	22	...

* And 24. † 15. ‡ 13 & 14. § 15 & 16. ‖ 24 & 25.

+Shows that the fall was above the average; —that it was below it.

METEOROLOGICAL NOTES ON FEBRUARY.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hail: S for Snow.

ENGLAND.

CAMDEN TOWN.—Only one day on which the temp. in shade reached 51°, and only four on which it did not go down to 32°.

LINTON.—A very dull, cold month, but not a wet one, the downfall being mostly in snow, the latter part of the month very wintry. Winds (never very high) mostly N. and E. Bar. very low on 24th, without much change. The month contrasts strongly with January, yet on the whole has been favourable to farming operations, if milder weather follows. Highest bar. (at noon) 30·18 on the 1st, the lowest 28·94 on 24th.

SELBORNE.—Mean max. ther. 39°·5; mean min. 30°·2; the coldest February excepting 1873 for 10 years. Considerable suffering from rheumatism; death-rate very high. It is remarkable that so mild a January should intervene between two such exceptionally cold months as December and February.

BANBURY.—High wind on 16th.

CULFORD.—An exceedingly cold month, the mean temp. being only 34°·6. Only five nights on which the mercury did not fall to or below the freezing point, the lowest being 17° on the 23rd, and the max. temp. of the last two days was only 32°. S fell more or less on six days, with heavy fog on 14th and 15th; cold easterly winds on 15 days.

BRIDPORT.—A cold month, and a great part of it very gloomy, with a prevalence of N. and N.E. wind.

BODMIN.—Rainfall (1·65) is 1·71 below the average of 26 years.

SHIFNAL.—Bees out, and throstles singing on the 15th. A most unusually severe February, and strange contrast to the previous mild month. The first three days were pleasant, the ther. standing at 50° on the 1st, but on the night of the 3rd frost set in, which continued, with two exceptions (12th and 13th), till the close. The average max. temp. was 40°, average min. 31°. Although the gauge records 1·56, ·97 of it was snow, a fall of 5 inches taking place on the night of the 20th, followed by frequent showers of sleet till end of month. Thick fog on 7th; S.E. winds prevailed from 7th to 11th, and N.E., from 18th to the close; the rest were N.W. or W.

ORLETON.—A very cold and cloudy month; at the beginning and in the middle there were a few warm days, the remainder very frosty, with low mid-day temp. The sun was rarely seen and the ground generally covered with S, which quickly melted or was dried up by the cold N.E. wind that prevailed. The mean temp. of the month was more than 5° below the average.

LEICESTER.—Very winterly weather, with the exception of a few days in the middle. Easterly winds more frequent than is usual in February. Bar. generally very high till the 19th.

BOSTON.—Temp. 3°·3 below average of the last 11 years; rainfall 1·33 above the average of the previous 20 years. N.E. winds much in excess of the average for February. On the 20th the snow remained on the ground to the depth of from 4 to 5 inches.

GRIMSBY.—A month of unusually cold unpleasant weather; E. winds during the latter half of the month, and in the last ten days the temp. never reached 40°, the highest point reached on 27th and 28th was only 33°.

NORTH SHIELDS.—Plants in flower at the beginning of the month—Christmas rose, auricula, white rock cress; on 8th, yellow aconite; in the middle of the month, snowdrop, snowflake, and yellow jessamine, and crocus on the 21st.

WALES.

HAVERFORDWEST.—This month was a striking contrast to the previous one, being cold, dry, generally overcast, and frosty, with cold E. winds. The mean temp. of the last 11 days was 33°·7. As usual this month had not much R, the

wind blowing from the E. from the 24th to 27th. S on the Precelly range from the 20th to the end of the month.

LLANDUDNO.—Only eight fine days, the remainder dull and cold, particularly the last ten days. Gorse in flower on 12th, hyacinth in full flower in the open garden on 13th; elder, honeysuckle, eglantine, and gooseberries in bud. S on the hills from the 21st to the end.

SCOTLAND.

DUMFRIES.—Month dry and cold; rainfall far below the average. Prevailing winds E. and N.E.

HAWICK.—First half of the month fresh and favourable for getting forward all kinds of out-door work; but the cold E. winds, the frost, S, and H of the latter half put an effectual stop to nearly all our out-door operations.

ANNANHILL.—Bar. pressure higher than last month from 1st to 11th, and from 15th to 22nd there were two periods of high pressure accompanied by cold E. winds and a low temp.; the prevailing winds were N.E., E., and S.E., usually light to moderate; strong N.E. gale on 24th, pressure 16 lbs. to the square foot. The month was cold and bleak, with blighting winds, ungenial and treacherous, there being only 6 days on which there was no E. in the wind. Rainfall, light.

CASTLE TOWARD.—Rainfall much below the average, and only on 7 days; the amount of sunshine small, and in the early part of the month great fog on the land and much greater on the water, river steamers being delayed, the river traffic both ways at a stand-still. On 23rd slight fall of S, followed by a heavy gale from N.N.E., and on 25th a slight fall of S, the tree-tops white; from the 25th cold E. winds set in, and the weather being bitterly cold, with winds drying the ground, farm operations were carried on speedily.

BRAEMAR.—The former part of the month fine, the latter part very severe.

ABERDEEN.—A month of dull, cold and rather dry weather, with piercing E. winds. S never deep except where it was blown. Mean bar. (corrected) 0·25 in. higher than the mean of 18 years; wind pressure considerably below the average, but the wind from E. and N.E. much above it; mean temp. 36°·7 or 1°·1 below the (18 years) average, and the R rather more than half-an-inch below it.

PORTREE.—A month of very severe frosts, most of the evergreen shrubs completely destroyed; gale on the 23rd from N.E. with drifting S. The severest February since 1866; sheep and cattle half starved, the pastures being all frozen up, and provender for hand-feeding very scarce. The rainfall 5·93 in. below the average of the last 15 years, 1860-74.

CULLODEN.—L seen on the morning of the 1st; intense frost on 6th; faint aurora in the N. on 11th; chaffinch began to sing on the 11th, and the thrush on 13th; violets and primula in bloom on the 12th. On 23rd constant S from 6 a.m. to 2 p.m., 3½ in. on the ground; sharp frost; half-an-inch of fresh S in the night of 23rd. On 24th slight showers of H and S drifting in the day; sharp frost and another half-inch of S during the night.

IRELAND.

DARRYNANE.—First half of the month very mild, but wet and foggy; winds variable and moderate. Second half dry and cold, with fresh N.E. winds during the last week. S on 24th, and frost daily from 15th to 24th, inclusive.

MONKSTOWN.—Weather nothing remarkable till the 20th; from then to the end of the month heavy R, alternating with S; heavy S on night of 23rd.

BALLYSHANNON.—The month has been an unusually dry one, but marked throughout by sharp winds (mostly easterly), and continued lowness of temp. There is but little sign of Spring yet. Frost at night, and light falls of S.

EDENFEL, OMAGH.—The weather of the month has been for the most part dry and cold, the last 10 days especially having been exceedingly bitter and inclement. On 22 days the wind blew from some point of N. or E.

Returns too late for insertion in table:—

Lochbroom.....	2·30	...	·28	16	17	...	...	...	...	...	...	...
Waringstown.....	1·46	...	·33	13 & 26	11	54·0	8	23·0	4	18	26

SYMONS'S
MONTHLY
METEOROLOGICAL MAGAZINE.

CXI.] APRIL, 1875. [PRICE FOURPENCE or 5s. per ann. post free,

REDIER'S BAROGRAPH.

THE instrumental and observational parts of meteorology are leaving the reductional and thinking parts far behind. Years ago the difficulty was to get instruments worthy of mental labour being devoted to the discussion of their results; now the reverse is the case, and there is a great tendency to amass piles of automatic records in the (generally vain) hope that some day or other they will be discussed. At the same time we have not the least wish to dissuade those who can afford it from providing themselves with self-recording apparatus, because though (unless they work up their own results) ninety-nine sheets out of every hundred will be merely a pleasure for a time and never looked at afterwards, yet the other sheet may be of the very highest scientific value. These points are so obvious that it can hardly be necessary to enlarge upon or to prove them.

The apparatus which has led to these remarks is, however, less open to them than most others, because it is (1) simple and easy to manage, (2) because there is no other element the autograph record of which is of more importance, and yet, (3) the cost is not large considering the quality of the work, which is that of high class clock makers.

We will first explain the engraving, and then say a few words, based on a careful examination of the instrument at Messrs Redier & Co.'s Factories*, also when in operation in the rooms of the Société Météorologique, and also of the diagrams produced by it during several months.

First then as to the explanation.

A.—A long but *extremely* light arm, hinged at its right hand end, resting upon F., and terminating in a small ratchet.
BB.—An ordinary syphon barometer tube.
CC.—The slab carrying the same.
E.—An escapement always in operation and tending to draw K. towards itself, and also to raise CC. and, therefore, also BB.
F.—A light float upon which the arm A. rests.
H.—The recording paper, which may be either arranged to be changed each three days, or for a period limited only by the length of the paper.
K.—The registering pencil.
M.—Winding screw for the train driving the escapement E.
N.—Winding screw for the train driving the escapement V.
O.—A little tapper driven by the movement R.

*Cour des Petites-Écuries 8, Paris.

P.—A pulley which turns as the slab CC. is raised or lowered, and which, therefore, compels K. to indicate every change.
Q.—Counterpoise to keep the chain from K. to P. tight.
R.—Clock movement driving the paper-covered cylinder.
R'.—Clock movement driving the tapper O. at intervals.
V.—A fly of which the speed is at least twice that of the escapement E.
XX.—Binding screws working in slots in CC.
Y.—The prime mover driven by a differential train (invisible) and working the axis of P. and the toothed wheel which raises or lowers CC. and BB.

The special features of this instrument are twofold; (1) the trouble, uncertainty, and expense of photographic registration are avoided; (2) the barometric column has scarcely any work to do, simply to support the light arm A, which only weighs a few grains; all the hard work, such as the friction of the pencil on the paper, is born by the clock movements.

For the benefit of such of our readers as may not have realized the precise mode of action from the engraving and from the detailed explanation of each part, we will conclude with a free translation of the description drawn up by M. Louis Redier (who, by the bye, is one of the Vice-Secrétaires of the Société Météorologique).

The motive force of any barometer whatever ordinary size one may give to the apparatus is only sufficient to lift a light needle, and will not overcome the friction of a pencil upon paper. If, however, we so arrange the apparatus that all the work is done by a powerful clock movement, and the barometer has only to direct the action of the clockwork, then it is evident that there is no limit to the work which can be done.

In the instrument under notice this is the case :—An ordinary syphon barometer BB is fixed to the slab CC and supported by the two buttons XX. A small ivory float (F) rests on the mercury and carries a very light vertical needle, on the top of which rests a very light arm (A) which has a small ratchet at its end.

By the side of the apparatus are two clock movements, one (M) terminates in the chronometer escapement E, and the other (N) in the fly V. These two movements work in opposite directions, and are so calculated that the speed of V is at least twice that of E.

A differential train unites this double system with the pulley P, to the axis of which a cog-wheel is attached, which works in a rack on the barometer slab CC.

Now let us assume that the movements are wound up—what will occur? The escapement E is constantly going and tends to draw the pulley and the pencil K, and to raise the barometer and its slab upwards; the arm A pushed by the needle F follows the movement, when the ratchet releases the fly V, and allows it to revolve. The speed of V being twice that of E, the movement N immediately brings the barometer down again until the fly is again arrested by the arm.

These small successive movements are, of course, followed by the pencil, and thus we have a straight line if the barometer is stationary, and one varying right or left according as the column rises or falls.

On the other side of the barometer are two other movements, one (R) driving the paper-covered cylinder, the other (R') driving a small tapping apparatus to overcome any capillarity in the barometer.

If desired, an arm of any required length can be attached to the pulley P, and it will then act as a wheel barometer.

We have not had an opportunity of testing the instrument ourselves, but from an examination of the curves we incline to believe that (excepting only the desperately expensive King's barograph) it is much the best non-photographic barometer yet known. This, however, is

only an impression, and we think it essential that strict comparison should be made.

The scale adopted is five-fold the natural scale, so that one barometric inch is represented by five inches on the diagram, but this is entirely optional and varies with the circumference of the wheel P.

VAN RYSSELBERGHE'S METEOROGRAPH.

[Although the article of which the following is an abbreviated translation, is skittish rather than scientific in its character, and (as is usually the case in controversial matters) errs in the excess of local partizanship, we think that there are a sufficient number of good points and home thrusts in it to justify us in appropriating to it the limited space into which (by the use of small type, and by abbreviating the translation) we have compressed it. The original occupies more than two columns of *L'Echo de l'Ostend*, March 28, 1875.—Ed.]

We reproduce *in extenso* an article which appeared on Monday last, in *L'Echo du Parlement*, in reply to the Scientific *feuilleton* of the same Journal of March 8th.

SAVANTS AND JURIES,

Irritabile genus!

Horace Ode x.

La Science se meurt!

La Science est morte!

in Belgium be it understood, for the article which appeared lately in our columns (let us say by M. D. to avoid periphrasis) has not extended to other countries the demonstration of this lugubrious theorem.

The theorem rests, moreover, on a lemma, which we will enunciate together with the demonstration, so that all may do justice to the last fragment of pure science in Belgium.

Lemma: *The Jury charged with awarding the quinquennial prize for the Physical and Mathematical Sciences have proved themselves guilty of cliqueism, of partiality, and incompetency.*

Yes.

(Here the names of the jury, seven of the most eminent men in Belgium, are set out).

Yes; they are all incompetent, all negligent, all partial!!!

And now let us give the demonstration.

I.—Their great fault is that they have not mentioned an exclusively physiological work by Prof. Delbœuf, although they have called attention to certain physical facts contained in an analogous work by Prof. Doeg.

II.—The Jury believing, doubtless, that two well-chosen words are preferable to a long sentence, have only devoted 6 lines to some works, but have given 8½ to others. M. D. evidently considers, on the contrary, that the appreciation of a work is measurable by the amount of paper occupied in praising it.

III.—The Jury profaning the worship due to pure science, has degraded itself by taking up the name of an obscure labourer, equally mortal and unknown!

In truth, wherewith does this new comer occupy himself, whom M. D. inveighs against from the height of his science?

Meteorology, Meteorography, study of the tides; mere trifles which have nothing in common with science. True, Euler, d'Alembert, Bernouilli, Lalande, and Laplace, occupied themselves therewith, the last with tidal questions and even observations during 43 years; true, Lubbock and Whewell devoted their lives to this insignificant subject, followed, in our own day, by such unknown men as Airy, Thomson, Sabine, &c. True, also, that Jelinek, Lamont, Secchi, Wild,

Wheatstone, and many others have laboured at Meteorography, what does it matter, the whole is of no moment.

Tell us the mode of reproduction of eels! there is a grand theme! there is a subject worthy of a really lofty genius!

But, alas! where are the Platonic worshippers of Minerva? the poor goddess languishes forsaken! and we her last faithful subjects! cover ourselves with ashes and weep! . . . .

Pleurer! car la science se meurt!
Pleurons! la science est morte!!

* * * * * *

After the *Thesis* let us see the *Antithesis*, and let us remark that the great body of scientific men have not always shared M. D.'s superb contempt for the mixed sciences.

I.—In 1860 the *Académie des Sciences* of Paris awarded the great prize to M. Giffard, the inventor of the miserable injector for locomotives, the author of a mere *improvement* in the feeding of boilers.

II.—The programme of the Geographical Congress to be held in Paris, next August, includes the study of "tide races," phenomena of which M. Van Rysselberghe gave a very plausible explanation at last year's Congress at Lille.

III.—The Scientific Society of Haarlem has, at its meetings during the last four years, repeated the following question, "Find a satisfactory mode of determining the temperature, pressure, &c., at a great height above the earth's surface, and automatically recording the same." This is only a special form of the problem theoretically and practically solved by M. Van Rysselberghe, and his solution must be very satisfactory, since the permanent secretary of the society has thought fit to appropriate our countryman's idea, and to announce it as his own to all Europe, after subjecting it to some disguises equally unhappy and indispensable.

It is by comparing simultaneous observations from numerous stations that meteorologists hope to learn to predict weather changes. Therefore the principal European observatories are in daily telegraphic correspondence, and mutually exchange their 8 a.m. observations. But what of the changes in the intermediate 24 hours. Here we must acknowledge that to the first development of meteorological science, a decided stoppage has succeeded. Now, M. Van Rysselberghe has designed a method whereby it is possible at a single central station to collect and read off momentarily the indications of a series of distant stations, so that when any disturbance arose it would be instantly perceived at the head office, and could be at once telegraphed to the Directors of other systems, who can do the same in exchange. And even if we do not thus arrive at a perfect knowledge of the coming weather, it is only necessary to wait until the astronomers have arrived at the laws of the disturbances of the sun, supreme regulator of the seasons, storms and tempests, as it is the prime cause of all that occurs on the surface of the world submitted to its jurisdiction.

Resuming, however, we may state that M. Van Rysselberghe has thought well, not only to completely solve the question of Meteorography, but—fancy what a mistake for *pure scienee*—he has not been content to do so theoretically on paper, but has actually had the apparatus made, and intends to study its indications so as thereby to determine the effects of atmospheric changes on the tides. Not only does he propose to establish a Physical Observatory at Ostend, but, also, possibly at other points on the coast! Verily, the enthusiasm of a novice is necessary for such a scheme, and the Government, the town of Ostend, the Royal Academy, the Jury of the Quinquennial Prize, in encouraging the efforts of this obscure young man, have *given to pure science, already so failing among us, a fresh blow, which will certainly hasten its extinction.* For this famous scheme of M. Van Rysselberghe's is as simple as it is fruitful, and his description of it in the Bulletin of the Academy is so modestly written, as to have the air of being of no moment. Yet, strange to say, hardly had these Bulletins been circulated over the Scientific World, ere there set in an ever increasing stream of Directors from the leading Observatories to examine fully the arrangements of M. Van Rysselberghe, and among them have been the Directors of the Observatories of Tiflis,

Utrecht, Montsouris, Puy de Dôme, Vienna, andLisbon, while among the other visitors have been such distinguished men as C. St. Claire Deville, inspector of French Meteorological stations; Balat, member of the Institute; and Carlsen, chief engineer of the Danish Hydrographic service.

If M. D.'s statement that the invention is a mere mechanical improvement had been correct, we much doubt if, to take a single savant as an example, M. Moritz would have undertaken a voyage from the Caucasus to Belgium, with the sole object of studying it.

The opinion of these learned Foreigners ought to have great weight with the writer of the feuilleton of March 8th, who pretends that in future the Belgian Government would do well to choose juries from other nations, since our own savants are decidedly incompetent.

Let him consult then many of the scientific periodicals of Europe, and he will see how the *idea* of our countryman has been received abroad. We may, in conclusion, invoke a single Belgian authority to whom M. D. can hardly object, as he has constituted himself, and rightly so, his warmest defender. M. Gloesner said, in August, 1873, "M. Van Rysselberghe has presented to the Académie a notice of real *scientific value.*"

TRADE WINDS.

To the Editor of the Meteorological Magazine.

SIR,—Maury's hypothesis, that the surface trade-wind of one hemisphere becomes the upper-current return-trade of the other, (Physical Geography of the Sea, sec. 122 to 139) was in all probability originally suggested by the well-known fact, that over the southern portion of the N.E. trade a S.E. upper-current prevails, and over the northern portion of the S.E. trade a N.E. upper-current; though he lays most stress on the arguments which he draws from the greater rainfall of the northern hemisphere (sec. 169 to 186) and from Ehrenberg's examination of the African air-dust (sec. 266 to 296).

A seaman on approaching the Doldrums, commonly notices a current overhead, blowing at an angle of about 90° with the surface trade; he is aware that this upper-current coincides in direction with the trade on the other side of the Doldrums; and that in the calm belt itself, there is an upward motion of the atmosphere. It is, therefore, not unnatural that he should conclude that the upper-current which he observes is a poleward extension of the opposite trade in the higher regions of the atmosphere. It may, also, I think, be admitted that the rapid and suddenly-shifting cloud-currents, often observed over the region of the Doldrums, are somewhat in keeping with Maury's idea of "curdles" or alternate strips of air.

I would suggest that this hypothesis (which many subsequent writers have been surprisingly ready to adopt) may, perhaps, be subjected to a crucial test, if an answer can be given to the following query:—When the S.E. trade draws so far to the north as to be deflected into a S.W. surface-wind, what is the prevalent direction of the upper-current *over the southern portion of the N.E. trade*? If it runs from S.W. it will be difficult to resist the conclusion that Maury is right: if from S.E., it will appear probable that the upper-current is (principally at least) the *N.E. trade*, deflected in the first part of

its return-course, towards the N.W., just as it is in the subsequent part towards the N.E.

Perhaps some meteorologist can give a definite answer to this question. The published data for its solution appear rather scanty; but so far as my own limited information goes, the observations are generally rather adverse to Maury's theory. Those made in the southern half of the squares 40 and 39 (between the parallels of 10° and 15° N. lat., and of 20° and 40° W. long.) in July and August, would be, perhaps, more valuable for this purpose than those from any other parts of the earth's surface. The subject may also be elucidated by analogous observations in the S.E. trade of the Indian Ocean, during the period when the N.W. monsoon prevails to the northward.

Yours truly,

W. CLEMENT LEY.

Ashby Parva, Lutterworth, April 6th.

PROTECTIVE INFLUENCE OF A LAYER OF SNOW AGAINST EXTREMES OF TEMPERATURE.

To the Editor of the Meteorological Magazine.

SIR,—The following thermometer readings may be of interest as illustrating the above.

Two thermometers, (Casella's sensitive forked bulb spirit minimum) one placed on the grass, the other 1 ft. above it, give usually a difference in reading of from 3 to 1½ degrees, the one placed 1 ft. above the grass giving the higher minimum.

During the late severe winter, the readings were reversed, that on the grass (when covered by snow or sleet,) giving a higher minimum than the one above it, as the subjoined readings will show. In order to be sure that the difference was not due to instrumental error, both thermometers were placed in water, which was gradually raised from 32° to 60° F. when their readings were found to coincide for each degree of increase in temperature.

1874.	Thermometer on grass.	Thermometer 1 ft. above grass.	Excess of Thermometer on grass.	
Dec. 17	25	23	+ 2	Covered with snow.
,, 22	17	15	+ 2	do.
,, 23	19	17	+ 2	do.
,, 24	20	16½	+ 3½	Frozen sleet.
,, 28	23	20	+ 3	do.
,, 29	24	23	+ 1	do.
,, 31	14	13 !	+ 1	do.
Jan. 1	14	13	+ 1	do.
Feb. 6	26	23	+ 3	Covered with hoar frost.
,, 20	29	28	+ 1	Covered with snow.
,, 25	30	28	+ 2	do.

Yours, &c.,

EDWARD CHAPMAN.

Magdalen Coll. Laboratory, Oxford, March, 1875.

AMATEUR RAIN GAUGES.

To the Editor of the Meteorological Magazine.

SIR,—Allow me to offer a few remarks in defence of amateur rain gauges, and to point out how, though I do not dispute a single word that you have said against them, they may still be useful in certain cases as pioneers for better ones. Many who probably would become good observers *if once they began*, are deterred from starting by the fear of expense. Before they have acquired by practice the requisite professional enthusiasm, an outlay of one pound is enough to frighten them. Let them, on the other hand, make a rough amateur gauge for a shilling or two, and only *begin* to observe, and the chances are very many that ere a year is over they will buy a good one, having meantime made *experimentum in corpore vili*. This was the case with myself.

Further, since I came out to Greece, I have endeavoured, in a small way, to copy your own example by establishing gauges in various parts of the country. I had to find my men (English or German always, for I have found no Greek requisitely minded)—to induce them to begin at all—and to supply them with instruments. I could not, and they neither could nor would be at the expense of procuring good gauges, neither would I, had I possessed good ones, have risked them on first experiments. What was I to do? I provided myself with some glass tubes from Casella, sealed at one end, had 5 in. funnels of tin made in Patras, which at least were not more than two or three per cent. wrong, graduated the tubes myself by aid of the graduated glass of my own standard gauges, and sent out these *corpora vilia* for the first experiments. I, of course, did not always succeed, but I have I hope fairly set going one station five miles from Patras, at the foot of the mountains, in German hands, and another in Argostoli, the capital of the island of Cephallonia, in the hands of an Englishman, who is taking very kindly to meteorology, and will, I think, procure good instruments, and continue and enlarge his observations after I have left the country.

Surely, then, amateur gauges are not always to be discouraged.

This country possess in its monasteries, scattered about in all kinds of positions and at elevations varying from the sea level to 4000 feet, the means of securing a most complete system of meteorological observations. Alas! no Greek, monk or layman, has hitherto so much as dreamed of anything of the kind.

I remain, yours faithfully,

H. A. BOYS.

Patras, Greece, March 6th, 1875.

METEOROLOGICAL OBSERVATIONS.

To the Editor of the Meteorological Magazine.

SIR,—Perhaps you would allow me as a rather inexperienced observer to state some of the difficulties which I meet, in order to draw from you or your readers any hints that may help at least such as myself.

1.—Schonbein's Ozone Papers. I find the tints of my papers very different from the numbered colours, so different that the two are not easily compared. Again, the papers are often much striped and mottled. In this case am I to take the general effect of the paper, or the deeper colour. Besides it is important to agree with others as to the time after dipping the paper at which we are to note the colour, as it changes a good deal.

2.—Force of Wind. Calculating force from velocity, am I to set down 0 for force till velocity comes up to 3, and then at once begin to set down 1 for force, and so on? or am I to divide midway between the numbers on the Beaufort Scale? I take the average velocity for 12 hours.

3.—Scott's Instructions. The figures in Table II. differ from those I have been using, Buchan's Introductory Meteorology, Table IV., *e.g.* for 800 ft. at 30° Scott gives ·907, while Buchan gives ·893, to be added.

4.—Even Glaisher's Hygrometrical Tables do not always agree with his own Table III., I believe.

5.—Stevenson's Box. The readings often vary a little after a time from what they are on the opening of the box. It would seem that the former are more nearly correct, but for uniformity the reading just after opening is, I suppose, the one to be recorded.

I mention these little differences, because, in point of fact, they are as great as the minor corrections which have to be made, rendering extreme accuracy apparently impossible. I should like, therefore, to hear what more experienced observers do under these circumstances.

I am, &c.,

J. D. P.

March 2nd, 1875.

[We think that the idea of putting such questions as the above through our pages is a good one. These so-called little matters are essential if the observations are to be (as we hold they should be) as good as possible. We do not reply to them because we think it will be better if other observers will favour us with their views, so that the subjects may not drop out of thought at once, but by again coming under the notice of observers obtain the attention which they merit.—ED.]

DAILY RAINFALL.

To the Editor of the Meteorological Magazine.

SIR,—It has struck me that it would be very interesting to many of your readers, if you could find space in your pages, for a *daily* return of the rainfall at Camden Square, especially to those, who like myself, live within a comparatively short distance of it; those of us who send in returns of rainfall to you, would then have an opportunity of comparing such a return from Head Quarters with our own.

Possibly you may be able to act on this suggestion in the future numbers of your Magazine.—I am, Sirs, yours faithfully,

A RAINFALL OBSERVER.

Muswell Hill, Middlesex, N., April 2nd, 1875.

[There are at least two reasons against this proposal. One is the trouble, the other the expense. As to the first, the interest which could attach to the returns of a single station could only be local, we hold, therefore, that if daily values are desired, it is necessary that they should be printed for at least eight stations, say three in England, one in Wales, two in Scotland, and two in Ireland. Assuming (which we know we may do) that the observers whom we may select for this duty volunteer to help, and are punctual, it still leaves to us the extra responsibility of an additional table each month. As to the expense, we need not tell those who are used to English printer's bills, what peculiar ideas are entertained on this side the channel as to the proper charge for tabular matter.

Let us, however, not be misunderstood, neither the trouble nor the extra cost will influence us for a moment if— and this is the crux— if our readers generally think that half a page appropriated to this object would be desirable, interesting, and useful. We are quite ready either to adopt the suggestion or to let it fall through, and await the opinion of our readers.—ED.]

SUPPLEMENTARY TABLE OF RAINFALL IN MARCH, 1875.

[For the Counties, Divisions, Latitudes, and Longitudes of these Stations, see Met. Mag., Vol. X., p. 28.]

Station.	Total Rain.	Station.	Total Rain.
	in.		in.
Acol	·68	Gainford	·84
Hailsham	·78	Shap	2·29
Strathfield Turgiss	·70	Llanfrechfa	2·88
Addington	1·10	Castle Malgwyn	1·46
Oxford	1·09	Heyhope	1·90
Cambridge	·37	Melrose	1·33
Sheering	·54	Cessnock, Glasgow	1·90
Ipswich	·51	Gruinart	1·70
Diss	·66	Keith	1·99
Swaffham	·41	Strathconan	3·09
Compton Bassett	1·08	Springfield, Tain	1·16
Hessary Tor, Dartmoor	4·30	Skibbereen	1·62
Teignmouth	1·30	Fermoy	1·70
Torrington	1·95	Kilrush	1·16
Falmouth		Kilkenny	·91
Taunton	1·24	Kilsallaghan	1·09
Cheadle	·71	Twyford, Athlone	1·02
Ashby de la Zouch	·63	Ballinasloe	1·02
Coston, Melton Mowbray	·70	Kylemore	2·89
Bucknall	·61	Bangor	1·82
Mansfield	·88	Carrick on Shannon	·82
Walton, near Liverpool	·71	Warrenpoint	1·94
Broughton-in-Furness	1·67	Bushmills	1·41
Stanley, Wakefield	·42		

REVIEW.

The Shannon (Flood-relief viâ *Belhavel). A suggestion* by MAJOR CAMPBELL, R.E. Dublin: Alex. Thom, 1874. Folio.

MANY "reports upon" and "surveys of" the Shannon drainage have been made, and they have generally been nearly as long and far more monotonous than the river itself. The present pamphlet is refreshingly bright and vigorous. Major Campbell has also, we believe, proved a true prophet, for, if we are rightly informed, the opening sentence of his pamphlet has been fulfilled to the letter.

"The Shannon Bill of Session 1874 (dealing with about two-thirds of the land liable to floods and half the river's length) will probably fail through the non-assent of two-thirds of the riparian proprietors concerned."

The whole question is, therefore, once more open to consideration, and for that reason we quote a few of the Major's terse paragraphs, and leave them to the consideration of our readers:—

"The floods appear to be simply 'matter misplaced.' They are threatening the neighbourhood of one part while they might be benefiting that of another."

"It is submitted that they might be more effectually controlled by leading the Shannon head-waters straight to Sligo than by any scheme, however skilful, for facilitating their tortuous descent to Limerick. A discharging channel from Lough Allen to Lough Gill (*via* Belhavel) is therefore recommended."

"It is now proposed to apply the remedy to the chief source of the evil, using Lough Allen as a flood-catcher, and giving it vent to the north-west to prevent floods, or to the south to create them, as may from time to time seem advisable."

"The Shannon and *the whole of its tributaries* would be treated as one drainage district; and the Executive near Lough Allen would deal with the sluices in that neighbourhood, as weather, and perhaps, telegrams, showed to be necessary."

"The following points are claimed in support of the scheme:—

"(1). That autumn floods can be prevented, the outfall at Meelick being reducible to five-sixths, or even four-fifths, of its present quantity.

"In spite of Mr. Symons' efforts, few rain-gauges exist in the Shannon basin, but the Loch Awe and Windermere precedents suggest that the rain-fall around Lough Allen may be taken as three times that in the basin discharging at Meelick.

"Cuilcagh, the highest of the mountains near Lough Allen, rises more than 2,000 feet above it; and the crest around the Shannon-source seems a probable place for a second 'Stye.'

"The rain-bearing wind from 'the mournful and misty Atlantic' is here checked for the first time by a cordon of hills."

"(2). That winter floods would be as possible as at present, but could be controlled.

"Experience of the works of 1839 shows that, in some cases at any rate, land was reduced in value by being deprived of winter floods.

"Whatever be the exact source of the benefits the floods cause—whether it be the carbonic acid from bogs, the natural top-dressing precipitated, the mere water itself, or all three—it seems well established, that a moderate degree of winter flooding improves some callows; if, however, the water lies too long, it becomes injurious."

"(3). That so long as floods are prevented, navigation is improved."

"(4). That the water-power on the Shannon will, in some cases, be improved."

"(10). That 3,000 horse-power might be created near Dromohaire."

"(12). That Sligo might be supplied with mountain water.

"A supply of water to Sligo has long been discussed; and the scheme has been to lead it by pipes from a distance of about four miles, at a cost roughly estimated at £25,000.

"For that sum Lough Allen water might probably be led from the out-fall near Dromohaire to Sligo, giving an inexhaustible supply of good water."

THE SEVERITY OF THE WINTER.

(*New York Times, February 16th.*)

People are apt to forget, from one season to another, what manner of weather they have heretofore endured. But though any uncommonly hot or uncommonly cold weather seems "unprecedented," it is generally agreed that this winter has been the most severe of which we have any record, at least for many years past. In almost every locality there are certain indications of extreme cold which are easily compared with those of former years, and these in every case prove the uncommon severity of this winter. In this region, for example, we see an unusual amount of ice in the rivers and bay. Not for a long time has there been so much difficulty in crossing the New Jersey and Long Island ferries. . . .

In the interior the cold has been excessive, the mercury falling to 41° below zero in several parts of this State ; and reports from New England and the North-west indicate a temperature even lower than this. Mercury congealed at Concord, New Hampshire, the other day, and, at several points in the far West, spirits lost fluidity when exposed to the air in an open vessel. Reports from the North Atlantic coast are filled with accounts of suffering and disaster from the extreme cold. Seamen are unable to work their vessels in consequence of the rigging becoming ice-bound, and many craft, coming on the coast, have been put down into the Gulf Stream in order to thaw out the running-rigging. Pilots agree that they have never before seen such hardship and difficulty at sea on account of ice and cold, and several lives have been lost on board vessels shut up by the icy embargo along our shores. Of course this extreme severity of the season is more noticeable in the Middle and Northern States, where the weather—when it is very cold—comes nearer to our ideas of Arctic experience than it does anywhere else in the Republic. But the cold wave or waves—for there have been several of them—seem to have spread all over the country. In regions where frosts are comparatively unknown, the thermometer has ranged very low, and there has been much rain. This is true of several of the Southern and Pacific States ; and invalids, though they have escaped the unusual terrors of this Northern winter, have not found in more favoured regions all the balminess of climate that they expected.

If there be any consolation in the universal companionship of misery and discomfort, we find that solace in reports that reach us from almost every part of the world. Even in the islands of the Pacific, which Herman Melville and others have described as an earthly paradise of bliss, the lightly-clad natives are astonished by low temperatures heretofore unknown. Travellers on the Mediterranean complain of leaden skies and uncomfortable days and nights. Americans visiting in the south of France wrire home dolorous accounts of cold and cheerless hotels, all unprepared for the sudden exigencies of such a winter as this. All over the British Isles, about the beginning of the year, the cold was intense, and the snow, especially in the south of England, was of unprecedented depth. In great country houses, where much merey-making was planned, visitors found great difficulty in keeping comfortable. Even along the north coast of Africa, where one would expect to find a tropical sky, the weather, in December, was said to be unusually cool, and the atmosphere not at all African.

There will be a loud call on scientific men for some explanation of these unwelcome phenomena. Whether the earth is passing through some boreal belt in the universe, or the axis of the globe is changing, the wise men only can tell us. We know that fossil remains in Arctic regions indicate that the equatorial belt was once where "the pole sticks up through the snow," and we believe there are those who predict that the earth will once more revolve at right angles with its present axis, when Quito will be inside the Arctic or Antarctic circle, and Spitzbergen will lie on the equator. What chiefly concerns us now, however, is the effect which this severe winter is having upon our people. In regions where the low temperature has only relative conditions, there need not be much suffering ; though we may suppose that the shivering Kanaka thinks he has fallen upon evil times when it is no longer comfortable to lie naked on the sand. But in our own neighbourhood there is undoubtedly a great deal of suffering among the poor, and a serious increase of mortality among all classes.

UNITED STATES DAILY WEATHER MAPS AND TABLES.

THE United States Government have most liberally sent over a number of copies of the above publication for October and November, 1873, for gratuitous distribution among British Meteorologists. We are authorized by the Director of the Meteorological Office to state that, until the stock is exhausted, he will have copies dispatched to any applicant who forwards to him the cost of postage, viz., one shilling for each of the two volumes. Communications should be addressed "The Director, Meteorological Office, Victoria Street, S.W."

RAINFALL AT LIKNÆS, FLEKKEFJORD, NORWAY,

About 7 Deg. E. Long., and 53·3 Deg. N. Lat. Top of Rain Gauge above Ground, 6 in.; above Sea Level, about 25 ft.? Diameter of Funnel, 5 in.

Month.	1872. Total Depth.	1872. Greatest fall in 24 hours. depth.	1872. Greatest fall in 24 hours. dte.	1872. Days on which ·01 or more fell.	1873. Total Depth.	1873. Greatest fall in 24 hours. depth.	1873. Greatest fall in 24 hours. dte.	1873. Days on which ·01 or more fell.	1874. Total Depth.	1874. Greatest fall in 24 hours. depth.	1874. Greatest fall in 24 hours. dte.	1874. Days on which ·01 or more fell.
	in.	depth.	dte.		in.	depth.	dte.		in.	depth.	dte.	
Jan. ...	21·260	..	...	26?	16·780	1·990	18	25	12·385	1·270	12	20
Feb. ...	5·745	2·070	19	14	2·055	·870	25	6	6·530	1·930	27	9
March.	5·010	2·090	28	10	1·970	·960	10	4	3·860	·700	16	10
April ..	2·470	·830	29	8	·950	·530	4	3	5·890	2·080	2	8
May ...	4·272	·500	15	15	3·530	·910	7	10	1·575	·605	30	4
June ...	5·300	·720	13	16	2·781	·620	10	14	2·280	·742	25	8
July ...	1·045	·440	10	7	4·740	·990	13	12	5·104	1·320	22	13
Aug. ..	4·768	1·300	26	11	8·550	1·260	16	23	9·190	1·500	10	14
Sept. ..	15·335	2·060	29	24	9·190	1·340	14	15	11·520	2·140	9	15
Oct. ...	12·460	1·540	30	21	13·065	1·440	19	19	16·840	2·150	6	18
Nov....	14·460	1·990	7	19	7·200	1·450	20	10	3·110	1·930	9	5
Dec. ...	5·225	1·200	7	13	8·230	1·450	15	15	1·720	1·000	4	2
Total ..	97·350			184?	79·041			156	80·004			126

1872.

The Register not begun till 23rd Jan.; the fall from 1–22 Jan. inclusive, is computed from Ex-Consul Jens Beer's register, about 4 English miles off, at 18·74 in.; 27 daily falls above 1 in. Jan., Sept., Oct., and Nov., were considered by the natives *very* wet. In Sept., a wooden bridge was washed away by an unusually high flood; it had not only stood previous floods, but great weights of floating ice after the breaking up of frosts.

1873.

19 daily falls above 1 in. No rain of any consequence from 25th Jan. to 26th July. A partially dry time in early part of December appears to have broken at the same time as the long period of high pressure in England gave way.

1874.

26 days on which upwards of 1 in. fell, and of these, there were 5 days on which upwards of 2 in. fell.

C. O. F. CATAR for BERNT OLSEN.

MARCH, 1875.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1860–5	Greatest Fall in 24 hours. Dpth	Greatest Fall in 24 hours. Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Max. Date.	Min. Deg.	Min. Date.	No. of Nights below 32°. In shade	No. of Nights below 32°. On grass
			inches	inches.	in.								
I.	ENGLAND.	Camden Town	·69	— 1·39	·28	7	11	59·5	31	27·1	5	12	16
II.		Maidstone (Linton Park)	·92	— 1·57	·28	2	8	62·0	31	26·0	19	17	...
,,		Selborne (The Wakes)	1·30	— 1·30	·69	5	7	56·0	31	27·0	4, 20	12	17
III.		Hitchen	·63	— 1·54	·21	6	11	55·0	8	21·0	4	20	...
,,		Banbury	·80	— 1·40	·37	6	9	57·0	8, 9	26·0	18	18	...
IV.		Bury St. Edmunds (Culford)	·42	— 1·78	·13	6	8	60·0	8	23·0	4,17	18	22
V.		Bridport	·70	— 2·17	·20	5, 16	5	57·0	31	24·0	21	10	..
,,		Barnstaple	1·23	— 1·92	·60	7	8	57·0	9	29·0	21	...	...
,,		Bodmin	1·83	— 1·92	·72	5	12	55·0	24	30·0	21	5	12
VI.		Cirencester	1·07	— 1·53	·37	5	5	...	...	...	...	...	...
,,		Shifnal (Haughton Hall)	·72	— 1·22	·22	7	10	57·0	7	26·0	20§	11	16
,,		Tenbury (Orleton)	·90	— 1·44	·29	5	11	60·0	31	25·0	21	13	17
VII.		Leicester (Belmont Villas)	·64	...	·21	6	9	57·0	31	26·0	5	...	...
,,		Boston	·43	— 1·36	·20	6	7	57·0	7, 8	30·0	20	7	...
,,		Grimsby (Killingholme)	·68	...	·28	6	12	56·0	8	29·5	5	3	...
,,		Derby	...	...	...	...	...	...	...	...	...	...	...
VIII.		Manchester	·82	— 1·87	·22	7	11	60·0	8	27·0	20	13	21
IX.		York	·55	— 1·44	·28	6	5	56·0	8	26·0	5	10	...
,,		Skipton (Arncliffe)	2·25	— 2·56	·67	6	12	...	...	...	...	...	...
X.		North Shields	·51	— 1·84	·16	8	9	54·3	26	31·0	20§	6	12
,,		Borrowdale (Seathwaite)	5·66	— 7·74	1·70	25	9	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely)	1·59	— 1·36	·95	6	6	...	...	...	...	...	...
,,		Haverfordwest	1·64	— 1·81	·60	6	8	54·2	24	28·0	17	8	14
,,		Rhayader (Cefnfaes)	...	...	..	...	...	...	...	...	...	..	...
,,		Llandudno	·89	— 1·37	·21	25	9	56·6	8	30·9	20	1	...
XII.	SCOTLAND.	Dumfries (Crichton Asylum)	1·43	— 1·55	·45	7	8	55·0	27	25·0	20	16	19
,,		Hawick (Silverbut Hall)	1·21	...	·54	8	7	...	...	...	...	...	...
XIV.		Kilmarnock (Annanhill)	1·41	...	·79	8	9	55·6	24	22·8	20	13	17
XV.		Castle Toward	2·27	— 2·32	1·05	9	8	56·0	30	...	...	14	...
XVI.		Leven (Nookton)	1·58	— ·49	1·15	8	10	60·0	30	27·0	20	11	22
,,		Stirling (Deanston)	...	...	...	...	...	...	...	...	...	...	...
,,		Grandtully	...	...	...	...	...	...	...	..	...	...	...
XVII.		Braemar	1·34	— ·87	·53	9	11	52·2	23	15·0	5	19	26
,,		Aberdeen	2·52	...	1·42	8	13	58·2	8, 30	29·8	16	2	13
XVIII		Loch Broom	2·72	...	·48	21	17	...	...	...	...	...	..
,,		Portree	3·73	— 6·31	1·08	8	16	...	...	...	...	...	...
,,		Inverness (Culloden)	1·78	— ·18	1·18	9	13	53 1	31	23·3	4	11	22
XIX.		Helmsdale	1·33	...	·41	8	12	...	...	...	...	...	...
,,		Sandwick	·83	— 2·50	·16	26	14	51·0	24	31·8	4	1	9
XX.	IRELAND.	Caherciveen Darrynane Abbey	2·35	...	1·00	5	8	...	...	...	...	...	...
,,		Cork	1·22	...	·46	5	8	...	...	...	...	...	...
,,		Waterford	1·31	— 1·58	·45	5	10	56·0	19*	33·0	1, 21	...	...
,,		Killaloe	1·34	— 2·98	·32	8	13	60·0	24	29·0	20	1	...
XXI.		Portarlington	1·32	— 1·99	·27	7	24	55·5	24	31·0	16	8	...
,,		Monkstown, Dublin	1·08	— 1·50	·69	5	5	...	...	...	...	...	...
XXII.		Galway	1·20	...	·31	8	9	57·0	15†	31·0	1	5	...
,,		Ballyshannon	1·15	...	·47	7	9	...	..	...	...	..	...
XXIII		Waringstown	·93	...	·20	8	15	59·0	7	25·0	19	6	14
,,		Edenfel (Omagh)	1·40	...	·55	8	18	52·0	7‡	28·0	9	13	...

* And 30. † 22, 24, 31. ‡ 24 & 25. § 21.

+Shows that the fall was above the average; —that it was below it.

METEOROLOGICAL NOTES ON MARCH.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hail S for Snow.

ENGLAND.

LINTON PARK.—First week wintry, the ground covered with S for several days; but cold, dull, dry weather set in on 9th, and continued with but very little change to the end, the winds (never very high) being mostly N. and N.E., and bar. generally high. A fine month for the husbandmen and, in fact, all out-door work; but the prevalence of cold winds is telling on delicate people, and vegetation is backward, but not more so than has been the case in some favourable seasons.

SELBORNE.—Prevailing winds N. and N.E.; very dry and bleak; fog, more or less, on 22 days; dense on 15th. Bar. mean of month, 30·01; temp. mean max. of month 45°·6; mean min. 34°·3. Colds in various forms almost universal. Fine time for the Lent sowing.

BANBURY.—Ball S on 1st and 2nd; high wind on 8th; sleet on 12th; R and S on 18th.

CULFORD.—A very cold, dry month, the mean temp. under that of January, viz., 40° to 41°·7. The rainfall less than half-an-inch; it rained only on eight days, during four of which S also fell. Easterly winds prevailed on sixteen days. Vegetation of all kinds very backward.

BRIDPORT.—A very fine, dry month, almost unprecedented for the small amount of R, and noted particularly for the prevalence of N.E. wind.

BODMIN.—Mean bar., 30·07; mean temp., 44°·6, being the exact average for Bodmin. Rainfall 1·65 in. below the average (26 years).

HAUGHTON HALL.—The driest March since 1854, and an unusually cold spring; the frost with which February closed lasted nightly to the 6th, when a mild interval occurred for four days, after which frosts occurred at night with little intermission to the close. The R that fell was so trifling that it did no good to the pastures, and owing to the scanty crop of hay last year, followed by a partial crop of turnips, hay rose to £7 or £8 per ton. The winds, except in the mild interval mentioned, came persistently from N.E. and E. till 16th, when they changed to N. and N.W. to the close. The bar. was equable, never falling much even during the Equinox. A gale from S.W. on night of 8th. Coltsfoot in flower on 9th, celandine on 25th, apricots not until 31st; rooks building on 10th, ring dove cooing on 16th, first humble bee on 24th.

ORLETON.—The sky was generally covered with cloud and the sun rarely visible during the month. With the exception of a few days about the 8th, the temp. was very low with a cold wind from the N. or E., and the ground frequently covered with a light coat of S till the 22nd, when it became warmer and continued so to the end of the month. The mean temp. was about 1½° below the average of the month; the fall of R was small, and the weather favourable for farming operations. On the 9th there was a strong wind with a high bar., and on the 18th the bar. rose to 30·41 uncorrected.

LEICESTER.—Very dry month; wind generally N. or N.E.

BOSTON.—Very strong gale and very high tide on the 9th; the temp. fell from 49° to 32°, and the bar. rose from 29·70 to 30·40 between the 9th and 10th. The month generally cold and dull, with scarcely any sunshine, although the mean temp. was about the same as that of March in the previous ten years. The prevailing winds have been from the N. and E., blowing from that quarter more than double the usual number of days. Rainfall 1·09 in. below the average of the last 20 years.

GRIMSBY.—A very cold month (a few days excepted) although the ther. was not often below freezing point; sky overcast; high bar., and rainfall very small, the fall of the last three months only 3·44. Rooks began to build on 4th; frogs spawning on 19th; yews shedding pollen on 8th; pilewort began to flower on 10th; the old moon in the arms of the new moon on 10th.

MANCHESTER.—A very dry month.

WALES.

HAVERFORDWEST.—The cold of February followed by the strong easterly winds of the present month, have almost neutralized the heavy rainfall of the previous four months, which exceeded 30 inches; the ponds and rivers are sensibly diminished. If the next month does not make up the deficiency, we shall suffer from drought. Last year's hay harvest was a total failure; at present hay is £8 per ton. The month has been dry, frosty and cold, E. winds generally prevailing: a very fine seed time, but a time of great mortality.

LLANDUDNO.—On the 4th, the sun struggled out for a few minutes, about 4 p.m., it had not been seen here during the previous ten days; snow on the distant hills on the 5th, several snow showers on the morning of the 13th, and severely cold on the first three days, otherwise a fine dry seasonable month, only one frosty night and nine days on which it rained.

SCOTLAND.

DUMFRIES.—Gale from S.W. on 7th; month dry and cold, E. and N. winds prevalent; in the first part of the month the mornings were often frosty; no violent gale; temp. 2° higher than that of February, but 6° lower than March last year.

HAWICK.—A cold and very ungenial month.

ANNANHILL.—Bar. high, reaching 30·639 on the 17th; mean pressure of the month 30·214, remarkable depression on 9th, 28·991, a great storm and heavy rain. Mean temp. 2°·2 above that of last month, slight rainfall, prevalent winds E.N.E. and E.S.E.; days generally cloudy, some of the evenings very bright; to 17th cold nipping winds, retarding vegetation of all kinds; after this date it was milder, allowing seed sowing to progress, and bringing out young foliage; death-rate during the month 39 per 1,000 of the population per annum; principal causes, consumption and bronchitis, number of fatalities being 78.

CASTLE TOWARD.—Weather very favourable for outdoor employment, the ground being in good order; both sowing corn and planting potatoes are finished in this locality; early planting of potatoes is considered likely to lessen the chance of disease. Some hard frosty mornings, temp. 24° on the 16th. Winds very piercing, generally E. Bar. high on 6th and 7th. Arran hill tops white with snow. Sheep and cattle healthy; and on the whole this month has been a favourable one.

BRAEMAR.—A month of severe, changeable weather. Lunar halo 15th.

ABERDEEN.—Notwithstanding the heavy fall of rain on the 6th, (·71) and 8th (1·42), the month was a very dry one. Mean temp. 41°·5 or 2°·1 above the mean of 18 years, the excess being entirely due to the warmth of the last ten days, the first three weeks of the month having been bleak and cold. Wind pressure below the average, but exceptionally frequent from N. and E.

LOCHBROOM.—This has been a much drier month than agreeable to the graziers; but on the whole it has been favourable to agricultural purposes, hence the culture of the soil is far advanced, and sowing began earlier than usual in this northern region.

PORTREE.—On the whole this month has been favourable for outdoor farm-work. Provender for cattle very scarce. This is the driest March since 1870. Slight fall of S on evening of 9th, and H and sleet on 18th, 20th, 27th, and 28th.

CULLODEN.—8th stormy N.E. wind; S on 5 days, the last being the 27th; L on 4th; solar and lunar halos on 15th.

SANDWICK.—This March has been drier than any one for the previous 19 years, and there have been only two drier during the whole period of observation, viz., 1852 and 1856, when the rainfall was, respectively, ·78 and ·34, this month it was ·83; so there has been no lack of "March dust," and the weather being mild, we have had a very favourable seed time. A flock of lapwings arrived here on 15th. Crocus in flower on 24th. Bar. steady and very high, being above 30 in. on 24 days.

IRELAND.

DARRYNANE.—A very fine dry month, with almost constant light E. and N.E.

winds; fresh gale from the S.E. on the 5th and forenoon of 6th, with very heavy rain (1·00) in the afternoon and night of 5th.

WATERFORD.—Great storm and sudden change of the weather on the 5th. Storm on 9th.

BALLYSHANNON.—The month has been one of unusual dryness. During the first part, cold piercing E. winds prevailed; the latter part was more mild and genial, and spring work is in an advanced state in this neighbourhood. The lake and river Erne have not been so low at this season for years.

WARINGSTOWN.—Cold and dry, very favourable for labour; but much sickness in consequence of harsh wind.

OMAGH.—Weather of the month cold, dry, and favourable as a seed time; but a late season as regards growth or vegetation.

POCKY CLOUD.

SIR,—As I have never carefully observed this cloud before, perhaps I may be excused if I send you a few lines about it as seen here January 27th, 1875. The morning was cloudy and mild, with vane at S.S.W.: the winter gnats were flying about. At 4.30 p.m. the sky in the S.W. was a dirty yellow up to the zenith; sun near horizon, low scud. At 4.30, in the S. and near the horizon were the dull yellow pocky clouds, their lowest edge being 10° of altitude. On the horizon beneath them lay dull yellow cumuli. They broke up in about 15 minutes. In the S.W., above the sun's place, lay black and golden clouds.

Snow fell on the 25th and 26th, and the 28th and 29th were gloomy, with rain.—Yours very truly,

JOSEPH GLEDHILL, F.R.A.S., &c.

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SYMONS'S
MONTHLY
METEOROLOGICAL MAGAZINE.

CXII.] MAY, 1875. [PRICE FOURPENCE or 5s. per ann. post free,

GREAT VARIATION OF SHADE TEMPERATURE, APRIL 21ST.

THE range of temperature in the spring is usually greater than that in any other season, if therefore, its normally large amount is abnormally increased, it becomes sufficiently marked to attract the attention of others besides meteorologists.

A case of this kind occurred on April 21st, when a northerly wind passed down over England. The following information is afforded by the Daily Weather Reports.

(1.) At Thurso the change had occurred, a fresh N.N.E. wind was blowing, and the temperature was down to 40° at 8 a.m., on 21st.

(2.) At Scarborough, at the same hour, the N. wind had just commenced, but was very slight, the weather was foggy and the temperature was 46° and falling.

(3.) At all stations south of Scarborough the morning was fine, the wind southerly or else calm, the temperature above 50°, and rising rapidly.

(4.) Between 11 a.m. and noon the N. wind reached Nottingham, and the temperature fell 16° in that hour.

(5.) The "Summary of the Weather in Western Europe," is as follows:—

April 21st.—The mercury had fallen at the Irish, English and French stations and on the eastern shores of the North Sea, and the area of lowest pressure had advanced over the south of Sweden, where the barometer had fallen more than half-an-inch. At the same time a recovery had commenced in the north of Scotland, so that the gradient from Aberdeen to Wisby was 0·05 in. Moderate to fresh breezes were reported, from N.E. over Scotland and from N.W. over Norway, while the W. wind in Denmark and the S.E. wind in the south-west still held. Elsewhere calms or variable airs prevailed. Temperature had fallen considerably in the north under the influence of the N. wind, while it had again risen in the south-east, and was unchanged elsewhere. The weather had become overcast in the north and west with snow at Christiansund and rain at Roches Point and Brest, but in the south-east the sky continued clear. As the day advanced the N.E. wind and cloudy weather extended S., accompanied by a very rapid fall of temperature, and in the evening heavy rain fell in the south-east of England.

We may now add a few letters and notes which we have received and which tend to complete the above records. We arrange them in the order in which the wind reached the stations.

Killingholme, Lincolnshire.—Temperature fell from 65° to 48° in the forenoon of 21st.—J. BYRON.

Mansfield.—At 9 a.m. the thermometer stood at 65°·6, wind S.W., the wind gradually shifted by W., N.W., N. to N.E., at 12.30 (noon), the thermometer falling 20°·5 during that time; at 9 p.m. it stood at 40°·3.—R. TYRER.

Coston.—Very sudden change of temperature, about 12·30 (noon), the wind changed from S. to N., the sky became overcast with threatening looking thunder clouds, temperature fell rapidly, and gusts of wind blew the dust along the roads.—A. M. RENDELL.

To the Editor of the Meteorological Magazine.

SIR,—Is it not but seldom, even in our changeable climate, that we have so great a variation in the shade temperature as was registered here during the 24 hours, ending at 3 p.m. on April 21st? Thus, temperature fell during 14 hours, ending 5 a.m., on 21st, from 71° to 35° = range of 36°, rose in 6 hours ending 11 a.m., from 35° to 72° = ditto 37°, fell in 4 hours, ending 3 p.m., from 72° to 51° = ditto 21°, making a total variation in 24 hours of 94°.

Will any readers of the Meteorological Magazine kindly point out any similar instances of such sudden and extensive changes of shade temperature.

I am, Sir, yours truly,

G. WARREN.

Merton Villa, Cambridge, April 22th.

Addington Manor, Winslow.—Wind west till 3 p.m., then changed very suddenly to N.E.—J. MATHISON.

To the Editor of the Meteorological Magazine.

SIR,—A most remarkable change of temperature and weather occured yesterday.

At 9 a.m. the sky was covered with cirrus, moving slowly from W.S.W., the weather being very hot and sultry, the thermometer standing at 66°·2.

During the afternoon the wind freshened from N.E., and at 6 p.m. the thermometer stood at 49°, having fallen from 70° at 2 p.m.; at 9 p.m. it had further fallen to 42°·4.

Rain commenced about 7.30 p.m. and continued steadily till 9 p.m.

At 8 a.m. this morning, a fall of frozen rain or pieces of ice commenced and lasted till 9.30 a.m.

The thermometer at 9 a.m. stood at 40°, or 26°·2 lower than at the same time yesterday

The max. yesterday was 70°·1, and to-day only 44°.

Yours truly,

THOS. PAULIN.

Enfield Chase, April 22nd, 1875.

To the Editor of the Meteorological Magazine.

SIR,—The sudden fall in temperature which occurred over the greater part of England on Wednesday, April 21st, was very rapid here.

At 4 p.m. the weather was overcast as it had been all day, and quite calm, the thermometer standing at 73° in the shade. At 5 p.m. a sudden high wind sprang up from the N.E., (the upper clouds moving from the W.) and at 6 p.m. the thermometer had fallen to 46°. The air was quite hot till 5 p.m.; but I was out, and so was not able to see the thermometer at that time, but it must have been above 70°. This would give a fall of 24° in the hour. There was no rain, except a few drops, till 7 p.m., and the wind had quite gone down at 10 p.m. The minimum next morning was 39°, giving a total fall of 34° in 17 hours. Yours truly,

W. C. HUGHES.

Sutton Valence, Staplehurst, Kent.

To the Editor of the Meteorological Magazine.

SIR,—One of the most remarkable changes of temperature which I ever recorded occurred here on Wednesday. At 9 a.m. dry bulb 62°. Dew point 46°·6. Max. for 21st was 76°·8, wind S.W. Soon after 3 p.m. wind shifted very suddely to N.N.E., with a very rapid decrease of temperature to 41°·8! by 9 p.m. At 9 a.m. of 22nd, dry bulb 38°·8. Dew point 37°·4. Wind N.E. Max. temperature (shade) on 22nd only 39°·7!! a difference of 37°·1 from the previous day. The *exposed* max. ther. was only 41°! or 1°·3 higher. During night of 21st the min. ther. was 36°·6. The weather until 18th has been cold and dry since January. This will be the latest spring since 1837.

C. L. PRINCE.

Crowborough Observatory, Tunbridge Wells, April 23rd, 1875.

We think that there are few cases in which the advance of a Polar wind has been more clearly marked, or more carefully recorded than in the above instance. It seems possible, even with the above data to approximate to its rate of southerly progress, and to fix it at from 20 to 25 miles per hour; but we think the phenomena worthy of further examination.

RAIN ON THE COTSWOLDS.

To the Editor of the Meteorological Magazine.

SIR.—We had a remarkable fall of rain for this district, on Thursday, 8th. It extended over the North Cotswolds, but not far away I believe. It began with snow, soon after midnight, turned to heavy steady rain about 2 o'clock a.m., and continued until 11 a.m., 1·60 in. fell during that time. I thought at first that my rain gauge must have been tampered with, but on going out the overflowing ditches and brooks and inundated fields showed how much had fallen.

There was no wind; but some said they heard distant thunder. We have not had such rain since I commenced observing the weather. I am, yours faithfully,

R. B. BELCHER.

Blockley, Moreton-in-Marsh, April 10th, 1875.

MOTION OF ICEBERGS.

To the Editor of the Meteorological Magazine.

SIR,—Icebergs have frequently been observed to travel in a direction different from that of the wind and also of the surface-current of the water, and their motion has in most cases been attributed to a different current of water below the surface acting on their base. In the Report of the recent Austrian Polar Expedition, the curious, and (so far as I am aware) novel observation is made that the ice in high latitudes commonly travels not exactly with the wind, but with a motion inclining from the right: thus, if the wind be S., the ice moves from a point W. of S.; if W., from a point N. of W., &c.

To the best of my knowledge no explanation of this phenomenon has yet been offered.

I hazard two suggestions for the consideration of your readers. To the first I am not inclined to attach much importance, but perhaps it ought not to be dismissed without reflection. The second appears to me to be intrinsically probable.

I. In inland localities of our own latitudes clouds at the altitude of 4000 ft. generally travel with a motion inclining from the right of the winds course, the mean angle at that elevation being about 15° with the surface wind. It seems improbable that at the summit of the highest icebergs the wind should make any noticeable angle with the wind as observed on the ship. It is, however, worth mentioning that it is characteristic of the weather within the arctic circle, as observed in the above Report and elsewhere, that very low clouds are frequently seen to travel with much velocity, when the atmosphere on the surface of the earth is calm. I have elsewhere shown a connection to subsist between the difference of direction and of velocity of the wind at, and above the earth's surface. (*Journal Scottish Meteorological Society, No.* 39). It is therefore conceivable that in those latitudes the wind, even at the slight altitude of the higher icebergs, may occasionally differ as much in direction as in velocity from the surface wind: though, if this were the case, we should expect the fact to have been otherwise noticed.

II. In a cyclonic circulation of the atmosphere the S. wind is pressed upon in the rear by a S.W., the W. by a N.W. wind, &c. It seems possible that the ice in the S. wind continues to travel from a South-westerly point, and that in the W. wind from a North-westerly point; to a slight extent, by virtue of its own inertia, in the case of very local circulations, such as attend electric showers; and to a greater extent, if closely packed, by the pressure of the ice moving in its rear, even when the wind-curve has a large radius.

In our own latitudes a S. wind not uncommonly has a S.E. wind in its rear, a W., a S.W., &c. But it is remarkable that these "anti-cyclonic" wind-curves diminish in frequency, both in Europe and America, as we get into higher latitudes.

It is to be hoped that this subject will receive further investigation in the Arctic Expedition, and that the direction taken by the ice will be carefully compared not only with that of the wind, but with other meteorological conditions existing at the time.

Yours truly.

W. CLEMENT LEY.

Ashby Vicarage, Lutterworth.

METEOROLOGICAL OBSERVATIONS.

To the Editor of the Meteorological Magazine.

SIR,—Having seen in your last issue a communication from "J. D. P." respecting "accurately recording Meteorological Observations, I beg to offer the following remarks.

1. (*Schonbein's Ozone Papers.*) I have used, and am now using, both "Moffat's and Schonbein's tests, and find, like "J. D. P.," the papers in both instances to colour differently from the numbered colours. I have had "Moffat's" tests colour when "Schonbein's" have remained quite white (both suspended in same cage and for same length of time).

Schonbein's are always either spotted or mottled, whereas Moffat's colour quite evenly. I can recommend to all ozone observers a book by Dr. Cornelius Fox, "Ozone and Antozone" (Churchill and Co.) in which he suggests two tests, one for *ozone alone* and one for estimating the amount of "air purifiers" (ozone, peroxide of Hydrogen, and Nitrous acid). This book treats the subject in a very able and exhaustive manner, (Mr. Casella, of Holborn, has promised to procure me some of his tests) and as they appear to be the only reliable ones, I hope they will become generally used. Observations will then become comparable.

2. (*Force of Wind*). I divide mid-way between the numbers on the Beaufort Scale.

3. (*Scott's Instructions.*) There are a number of tables published for reducing barometrical readings, but none seems to agree with the others. *I use Sir Geo. Shuckburgh's* theorem, (vide page 214 Drew's Practical Meteorology, 2nd Ed.) "that the height of a column of air which shall cause a rise of 1 inch of mercury, at a temperature of 32° is 868·5 ft.," this nearly agrees with Scott's, as at 800 ft. elevation temperature 50°, there is only a difference between them of ·005 in., naturally at lower elevations this is *very considerably* reduced. Buchan, (page 19) uses 875·1 ft. as the height to balance 1 inch of mercury at 32°. I think it would be advisable for observers to come to some understanding as to what tables should be employed.

4. *Glaisher's Tables.* I use Regnault's tensions, with "Apjohn's formulæ," although this method is longer, it is *generally*, I find, more accurate.

Respecting a letter from a "Rainfall Observer," at Muswell Hill, with reference to inserting "daily return of rainfall; at Camden Square," in the Monthly Magazine, I trust you will be enabled to

publish such a return in future, as it would be interesting to compare the results day by day.

Apologizing for the length of this,—Yours truly,

KAUFMANN J. MARKS.

14, *Warrington Crescent, Maida Hill, W., 23rd April*, 1875.

P.S. Since writing the above, and with respect to No. 3 "Scott's Instructions," I find the different authorities in computing the barometrical reductions for heights have employed different "co-efficients of expansion," for instance (Drew ·00204,) (Buchan, Laplace ·004,) (Guyot's tables Gay Lussac ·002083,) (Regnault ·002036,) no wonder that the tables differ. The question is, which are we to use?

[As regards the publication of daily rain values, our correspondents have been remarkably silent; the remark in the above letter is the only one (!) we have received. Unless we receive many others we shall assume that there is no *general* desire for it.—ED.]

PROTECTIVE INFLUENCE OF A LAYER OF SNOW.

To the Editor of the Meteorological Magazine.

SIR,—Your correspondent, Mr. Chapman, may probably be interested in the following readings of two spirit thermometers, verified at Kew, one in a louvre stand, the other on the grass. The readings were taken at 9 a.m., the ground in each case being covered with fresh snow.

Date.	Stand.	Grass.	Depth of Snow in inches.	Date.	Stand.	Grass.	Depth of Snow in inches.
Nov. 10	32	32	$2\frac{1}{2}$	Dec. 20	21	25	1
,, 20	33	32	2	,, 21	13	20	$1\frac{1}{4}$
,, 21	30	32	2	,, 22	12	16	1
Dec. 2	32	32	4	,, 26	29	32	5
,, 5	26	29	1	,, 27	11	30	9
,, 8	27	29	$1\frac{1}{2}$	,, 29	14	18	1
,, 10	29	32	6	Jan. 31	22	30	3
,, 12	33	32	$3\frac{1}{2}$	Feb. 13	26	31	$3\frac{1}{2}$
,, 13	33	32	$7\frac{1}{2}$	,, 28	34	32	1
,, 14	18	29	6				

I regret not having put down a maximum and minimum thermometer when the snow first fell: the warmth of a mass of snow must be considerable. The depth in the garden all the winter was $2\frac{1}{2}$ to 3 feet. Before it fell, pansies, auriculas, and delicate garden plants were just coming into bloom, and there was a large bed of spinach. When the snow melted in early March all were as fresh as before it fell, and the pansies in bloom in no time. The wild flowers, too, are out as soon as the snow is gone, sometimes, as in the case of crocuses and snowdrops, pushing through the snow; indeed, at this moment, on the higher grounds, the snowflake (Leucojum vernum) is blooming abundantly, in some cases having forced its bloom through 5 inches of snow.—Yours truly,

MICHAEL FOSTER WARD, F.M.S.

Rossinière, Canton Vaud, 20th April, 1875.

METEOROLOGICAL OBSERVATIONS AT ROSSINIÈRE.

Lat. 46° 28′ Long. 7° 5′ E.

Monthly Means of Meteorological Observations taken at Rossinière, Switzerland, 3019 *ft. above sea level.*

1874.	Daily mean of Bar. red. to 32° Fah.	Thermometers. Extremes. Max.	Min.	Grass.	Means. 9 a.m.	Max.	Min.	Grass.	Days on which Ther. fell to or below 32	15	10	5	0	Days on which Ther. did not go above 16	20	32	Cloud 0—10	Absolutely cloudless days.	Rain Gauge. inches.	No. of days on which R or S fell.	No. of TSS
March	27·116	67°	3°	— 2°	34·4	48·6	25·0	20·5	24	6	2	1	...	...	...	...	3·6	13	2·240	13	...
April.....	26·851	75	28	19	49·4	60·6	35·2	30·8	7	...	...	...	...	...	...	...	4·1	10	2·642	13	8
May.....	·848	81	25	22	48·6	58·4	34·4	31·4	16	...	...	...	..	...	...	...	4·7	7	4·060	19	3
June.....	27·060	86	37	35	60·8	71·3	46·7	43·5	...	...	...	...	...	...	..	..	4·0	12	8·710	16	11
July.....	·038	89	44	42	67·5	76·8	52·8	50·3	...	...	...	...	...	...	...	...	2·8	18	9·860	17	13
August.....	·023	76	40	36	60·3	66·9	45·9	43·2	...	...	...	...	...	...	...	...	2·8	23	5·220	9	4
September.	·073	80	34	31	57·7	67·1	45·5	42·4	...	...	...	...	...	...	...	...	1·7	18	1·980	6	...
October.....	·025	68	24	21	43·4	56·1	36·6	32·7	9	..	...	...	...	...	...	...	3·3	15	3·150	7	...
November.	26·880	56	2	— 4	29·2	38·7	23·1	18·7	30	7	4	2	...	...	...	...	3·7	17	7·865	12	...
December..	·641	46	—5	— 7	19·9	24·5	15·9	8·8	31	16	10	6	3	8	11	22	5·0	11	6·805	18	...
Jan., 1875.	27·032	52	—7	—10	27·8	35·1	23·4	21·1	23	4	2	2	1	1	1	8	5·5	7	6·515	16	...
February...	26·792	44°	—5°	— 7°	19·5	31·8	13·7	11·1	28	17	10	6	3	...	...	16	4·3	13	1·105	9	...
	26·948	...	...	...	43·2	52·9	33·2	29·5	168	50	28	17	7	9	12	46	3·8	164	60·152	155	39

M. F. WARD.

[The above Table is a continuation of that given in Vol. ix., p. 38, and should also be compared with the translation of Prof. Dufoure's paper on p. 65 of the same volume.—Ed.]

REVIEWS.

Climatologie de la ville de Fécamp, ou résumé général des observations météorologiques faites en cette ville, 1863 *à* 1872. Par. E. MARCHAND, Pharmacien, &c. Le Havre: Lepelletier, 1874. 8vo.

M. MARCHAND has been a careful meteorological observer during twenty years; at the end of the first ten he published a summary of the results he had obtained, in the present work he gives an abstract of the second ten years' observations, but incorporates also the previous series. We are inclined to think that this second series is superior to the first, and is in many respects of considerable value.

A few words are requisite respecting the position of Fécamp and the situation of the instruments, but not many.

Fécamp is in the N.W. of France, in lat. 49° 45′ 24″ N. and long. 0°22′ E., and is therefore on the coast of the channel opposite Beachy Head; the observations were made in a garden in the centre of the town, the rain gauge was about 3 ft. above the ground, and about 65 ft. above mean sea level. The thermometers were good ones and their zeros were verified several times each year; they were 4 ft. above the ground, 7 in. distant from the external wall of an open coach house, running from N.W. to S.E., and forming with another wall of which the direction is prolonged towards S.E. an angle of 90° at 2 ft. 6 in. from the instruments. This wall is 12 ft. high. It is very desirable that M. Marchand should publish a series of simultaneous observations of the thermometers which he has hitherto used, and of either M. Renou's *thermomètre fronde* or of a thermometer on an ordinary French thermometer stand.

As the best mode of determining the mean daily temperature at stations of the second order (*i.e.* where two or more sets of observations are made daily) is still a debated point, we translate the paragraphs which refer to this subject.

"The thermometers are read daily at 6, 7, or 8 a.m., (according to the season) at noon, at 6 p.m., and at 10 p.m. The min. is read at noon, and the max. at 6 p.m.

"The mean daily temperature is determined by three different methods."

"(1.) By taking the mean of all the observations, except the max. and min.

"(2.) By taking the arithmetical mean of the max. and min.

"(3.) By the method indicated by Kaemtz, *Cours Complet de Météorologie p.* 21*, that is to say by multiplying the mean range by the following co-efficients, and adding the product to the mean min. temperature :—

* Walker's Translation, p. 23.

January.....	0·507	May	0·459	September...	0·433
February ...	0·476	June	0·453	October	0·447
March	0·475	July	0·462	November...	0·496
April	0·466	August	0·451	December ...	0·521

As probably few of our readers are familiar either with these co-efficients or with their effects, it will be well to go rather fully into the subject. And, first, let us try to make clear to every one, precisely what these figures imply. Any one who will read method (3) carefully, will see that if the tabular numbers were 0·500 the result of their employment would be *nil* or, rather, it would be just the same as the result of method (2). Example:—

Mean maximum temperature	60°
,, minimum ,, ...	40°
,, range of ,, ...	20°

Method (2)		Method (3) with assumed factor.		Method (3) with true factor.	
Mean max.....	60°	Mean range.....	20°	Mean range	20°
,, min.....	40°	Factor assumed ...	0·500	Factor (for April)...	0·466
	2)100		10·000		9·320
		Add mean min. ...	40·0	Add mean min. ...	40·0
Mean of M. and m.	50°				
		Mean by method (3)	50°0	Mean by method (3)	49·320

We, therefore, find that the effect of these factors is to give values slightly higher than the arithmetical mean in January and December, and considerably lower in the summer and early autumn. On the mean of the year the factor is 0·470, and this (as a little calculation will prove) is equal to a reduction of 0°·3 for each 10° of mean daily range. Therefore, practically, the matter amounts to this, that the mean obtained by the use of Kaemtz's factors is about 0°·3 lower than the arithmetical mean of the max. and min. Our readers will recollect that Table VI. of the old, and Table IV. of the new edition of Glaisher's Diurnal Range Tables gives a series of subtractive corrections, except for December. The mean of Glaisher's corrections is, however, greater than that given by those of Kaemtz's—in short, we have, if we take M. Marchand's mean values:—

Mean of 4 observations (daily)	50°·13
,, of max. and min.	50 ·16
,, ,, ,, with Kaemtz's corrections	49 ·85
,, ,, ,, ,, Glaisher's ,,	49 ·08

Which of the three plans is correct we do not know, perhaps, before the Greek Calends the Meteorological Committee will work up the results of all their thermographs, and thereby throw some light upon the question.

We must proceed to give a tabular abstract of the principal data, and shall subsequently call attention to some of M. Marchand's general remarks.

Abstract of Meteorological Observations at Fécamp.

DATE.	MEAN PRESSURE.	TEMPERATURE 1853–72.							RAIN.	CLOUD.
	1864—72 10 a.m., noon, 4 p.m., midnt	Mean Max. and min	Absolute Max.			Absolute Min.				
	in.	deg.	deg.	Year.	Day.	deg.	Year.	Day.	in.	0—10
Jan. ...	29·856	38·7	59·2	1864	21	9·9	1871	5	3·07	6·7
Feb....	·940	40·5	61·5	1870	28	16·3	1864	7	1·51	6·3
March	·817	42·9	64·8	1871	24	22·8	1865	21	2·25	6·2
April..	·946	48·8	77·5	1861	17	28·2	1864	9	1·90	5·8
May ...	29·917	53·3	84·7	1868	19	32·4	1872	5	2·53	5·3
June...	30·015	58·5	90·3	1858	15	38·7	1869	12	2·07	5·3
July ...	29·947	61·8	92·7	1869	20	41·5	1863	19	2·35	5·1
Aug....	·948	61·8	89·6	1857	3	40·8	1864	12	2·67	5·2
Sept ...	·923	58·7	83·7	1868	7	36·5	1860	11	3·53	5·3
Oct.	·848	52·8	78·1	1859	5	30·6	1869	30	4·14	6·4
Nov ...	·900	43·8	64·4	1857	3	18·5	1858	23	3·15	6·7
Dec....	29·895	40·5	59·7	1856	7	4·5	1859	20	2·89	7·1
Year...	29·913	50·2	92·7	1869	...	4·5	1859	...	32·16	5·9

(To be continued).

Cardiff Naturalists' Society. Report and Transactions, vol. v. 1873. Cardiff "South Wales Daily News" Office. 8vo. 106 p.p.

IT is some years since we drew attention to the progress of this Society, and as it has gone on steadily and prosperously in its career of usefulness, there is not even now very much to be said. The president of the year, Mr. W. Adams, C.E., F.G.S., inaugurated the session with a soirée and exhibition of curiosities of science and art, antiquities, &c. The Society, also, started a series of lectures on Science and Literature, and succeeded in rendering them a financial success, an unprecedented phenomenon in Cardiff, we believe. Eleven papers were read before the Society during the session, several of them of more than average merit, *e.g.*, "Impressed Limestone Pebbles, as illustrating a new principle in chemical geology," by H. C. Sorby, F.R.S.; "The Ancient Iron works of Tintern," by W. Adams, C.E., and "Six-monthly Flora of Cardiff and Neighbourhood," by Miss Ollivant—from whose good paper we must cull one paragraph even at the risk of being unpolite. And if, as is quite right, reviewers judge literary and scientific work on its own merits, and independently of the sex of the writer, if under these conditions a lady earns and receives praise for good work, she must not object to supplying a little harmless fun by our calling attention to the remarkable grammatical or horticultural phenomenon recorded in the following paragraph. We have underlined the puzzling words:—

"In a garden, opposite the Mumbles, might be seen some time back a plant of the Hedera Chrysocaropa—yellow-berried ivy—which is stated by botanists

only to grow at Rome, Naples, the Island of Scio, and at Constantinople, on that part of the wall where the Turks entered the city, A.D. 1463. No one can positively account for the presence of this plant in Glamorganshire; but an ancestor of the garden, in 1851, was a traveller, and fond of his garden when at home. He may, possibly have brought the plant from one of the four places named above; other plants have since been propagated from the one in this garden at the Mumbles."

The Meteorological department of the Society's work is efficiently conducted by Mr. F. G. Evans, F.M.S., &c., and embraces seventeen stations, ranging in altitude from 35 ft. to 730 ft., and in rainfall in 1873, from 32·88 in. at Cardiff to 84·59 in. at Treherbert. We notice one station which has in some mysterious manner failed to find a place in *British Rainfall*. We hope in another year to see Glyncorrwg in its proper place in that publication.

BOOKS RECEIVED.

AUSTRALIA.

ELLERY, R. L. J. Esq. "Observations in Meteorology, Terrestrial Magnetism, &c., at Melbourne Observatory, January—August, 1874."

AUSTRIA.

JELINEK, C., und F. OSNAGHI. "Jahrbucher der K. K. Central-Anstalt für Meteorologie und Erdmagnetismus, Jahrgang, 1872." 4to. Vienna, 1874.

BARBADOS.

RAWSON, Governor. "Rainfall in Barbados, October, 1874—January, 1875." Fcap. folio.

BELGIUM.

"Annales de l'Observatoire Royal de Bruxelles, March and April, 1875." 4to.
QUETELET, M. E. "Note sur la Température de l'Hiver, de 1874—1875." 8vo.

CANADA.

KINGSTON, Prof. G. T. "General Meteorological Register for the year 1873." Magnetical Observatory, Toronto. 8vo.

CEYLON.

FYERS, A. B., Lieut.-Col., R.E. "Results of Meteorological Observations at Ceylon for August—October, 1874."

DENMARK.

"Bulletin Météorologique du Nord, publié par les Instituts Météorologiques de Norvége de Danemark et de Suède." Oblong 4to. November, 1874—March, 1875.

FRANCE.

BELGRAND, M. E., and M. G. LEMOINE. "Observations sur les cours d'eau et la pluie, centralisées pendant l'année, 1873." Folio.
LEMOINE, M. G. "Résumé des Observations Centralisées pendant l'année, 1873." 8vo. Versailles: Aubert.
MARIE-DAVY, M. "Annuaire Météorologique et Agricole de l'Observatoire de Montsouris pour l'an, 1875." 16mo. Paris: Ganthier-Villars.
MARIE-DAVY, M. "Bulletin Mensuel de l'Observatoire de Montsouris, January—April, 1875." 4to.

GREAT BRITAIN.

AIRY, Sir G. B. "Greenwich Magnetical and Meteorological Observations, 1872." 4to.

MARTIN, J. "Horizontal Currents and Eastation." 8vo. London : Stanford.

MILLER, S. H., F.R.A.S., F.M.S. "The Fenland Meteorological Circular and Weather Report, February—April, 1875." Fcap. folio.

MAIN, Rev. R., M.A. "Results of Meteorological Observations made at Radcliffe Observatory in 1872." Large 8vo. Oxford : Parker. 1875.

PRINCE, C. L., F.R.A.S., F.M.S., &c. "Summary of a Meteorological Journal kept at Crowborough Beacon Observatory, 1874." Fcap. folio.

"Report of the Permanent Committee (of the first International Meteorological Congress at Vienna) for the year 1874." Large 8vo.

"Report of the proceedings of the Conference on Maritime Meteorology held in London, 1874." Large 8vo.

"Report on Weather Telegraphy and Storm Warnings, presented to the Meteorological Congress at Vienna, 1873." Large 8vo.

"Rugby School Natural History Society's Report for the year 1874." 8vo. Rugby : Billington.

"Stonyhurst College Observatory—Results of Meteorological Observations, 1874." 8vo. Robinson, Preston.

SAWYER, F. E., F.M.S. "The Meteorology of Sussex." 16mo.

SMYTH, J. junr., M.A., C.E., F.C.S. "On the Industrial Uses of the Upper Bann River." Large 8vo.

STEPHENSON, Rev. Nash, M.A. "The Rainfall in the County of Hereford during the year 1874." 16mo. *Hereford Times* Office, 1875.

ITALY.

RAGONA, Prof. D. "Sulle Burrasche del 19 e del 25 Febbraio, 1875." 16mo.

PRUSSIA.

BOGUSLAWSKI, Dr. G. "Bericht über Wetter-Telegraphie und Sturmwarnungen, Berlin, 1874." Large 8vo.

KARSTEN, G. "Ergebnisse der Beobachtungsstationen au den deutschen Küsten, March—July, 1874. Oblong 4to. Berlin : Wiegandt.

RUSSIA.

WILD, Dr. H. "Über den Täglichen und Jährlichen Gang der Feuchtigkeit in Russland." 4to. St. Petersburgh, 1875.

WILD, Dr. H. "Annales de l'Observatoire Physique central de Russie, 1869." 4to. St. Petersburgh, 1874,

WILD, Dr. H. "Repertorium für Meteorologie herausgegben von der Kaiserlichen akademie der Wissenschaften Band IV." 4to. St. Petersburgh, 1874.

SWEDEN.

HILDEBRANDSSON, M. H. H. "Essai sur les courants supérieurs de l'atmosphère dans leur relation aux lignes isobarométriques, Upsala, 1875." Oblong 4to.

UNITED STATES.

"Report of the Chief Signal Officer to the Secretary of War for the year 1874." 8vo. Washington, 1874.

APRIL, 1875.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1860–5	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Date.	Min. Deg.	Date.	No. of Nights below 32° In shade	On grass
			inches	inches.	in.								
I.	ENGLAND.	Camden Town	1·53	+ ·40	·66	8	10	74·0	21	29·3	25	3	8
II.		Maidstone (Linton Park)	1·38	+ ·16	·75	9	9	76·0	20	27·0	25	5	...
,,		Selborne (The Wakes)	1·74	+ ·24	·44	6	12	68·0	21	24·0	25	9	13
III.		Hitchen	1·58	+ ·58	·64	8	11	64·0	28	26·0	22	9	...
,,		Banbury	2·13	+ ·97	·73	7	10	69·0	20	27·0	14	2	...
IV.		Bury St. Edmunds (Culford)	1·05	+ ·30	·41	8	7	69·0	21*	25·0	22¶	9	10
V.		Bridport	1·07	— ·41	·21	8	10	60·9	20†	27·0	25	5	..
,,		Barnstaple	2·16	+ ·15	·47	7	11	74·0	21	35·0	25	...	...
,,		Bodmin	2·13	+ ·43	·45	4	13	68·0	19	34·0	2	0	4
VI.		Cirencester	1·98	+ ·69	·52	7	9	...	...	...	...	...	...
,,		Shifnal (Haughton Hall)	·66	— ·49	·25	6	6	63·0	19	27·0	14	6	9
,,		Tenbury (Orleton)	1·14	— ·40	·30	6	8	72·8	20	27·2	14	5	11
VII.		Leicester (Belmont Villas)	1·23	...	·33	7	9	73·2	20	29·0	23	2	...
,,		Boston	·43	— ·54	·14	9	7	73·0	20	30·0	14¶	4	...
,,		Grimsby (Killingholme)	·33	...	·11	7	8	67·0	20	31·5	14	1	...
,,		Derby	...	...	...	...	...	...	...	...	...	...	...
VIII.		Manchester	·90	— ·86	·28	6	6	76·0	19‡	28·0	14	2	3
IX.		York	·44	— ·66	·19	4	4	73·0	20	30·0	14	1	...
,,		Skipton (Arncliffe)	3·01	— ·03	1·08	3	9	...	...	...	...	...	...
X.		North Shields	·76	— ·55	·21	8	9	65·0	29	31·8	14	1	...
,,		Borrowdale (Seathwaite)	4·53	— 2·37	2·19	2	6	...	...	...	...	...	2
XI.	WALES.	Cardiff (Ely)	2·68	+ ·75	·63	5	10	...	...	...	...	...	...
,,		Haverfordwest	2·77	+ ·91	·80	4	12	68·6	20	30·0	22	5	...
,,		Rhayader (Cefnfaes)	...	...	...	...	...	...	...	...	...	..	16
,,		Llandudno	·94	— ·56	·30	4	6	70·0	19	35·0	14	...	...
XII.	SCOTLAND.	Dumfries (Crichton Asylum)	1·26	...	·33	3	8	69·8	20	27·4	22	1	...
,,		Hawick (Silverbut Hall)	·97	...	·29	27	8	...	...	...	...	...	4
XIV.		Kilmarnock (Annanhill)	·92	...	·33	2	9	67·2	21§	27·5	22	1	...
XV.		Castle Toward	1·15	— 1·35	·45	3	6	67·0	20	...	...	3	10
XVI.		Leven (Nookton)	·76	— ·49	·16	5, 27	8	72·0	20	29·0	22	3	...
,,		Stirling (Deanston)	...	...	...	...	...	...	...	...	...	...	19
,,		Grandtully	2·17	...	·31	6	10	...	...	...	...	...	...
XVII.		Braemar	1·25	— ·15	·32	5	11	68·4	20	27·0	22	10	...
,,		Aberdeen	1·55	...	·64	5	9	76·2	20	33·1	17	0	25
XVIII		Loch Broom	1·84	...	·66	5	11	...	...	...	...	...	6
,,		Portree	2·91	— 2·36	1·39	2	11	...	...	...	...	...	...
,,		Inverness (Culloden)	·99	— ·48	·24	21	21	71·1	19	31·0	13	2	...
XIX.		Helmsdale	1·84	...	·74	5	12	...	...	...	...	...	19
,,		Sandwick	2·61	+ ·87	·80	28	13	57·9	19	33·6	13	0	...
XX.	IRELAND.	Caherciveen Darrynane Abbey	3·12	...	1·00	4	9	...	...	...	...	...	8
,,		Cork	1·09	...	·34	25	7	...	...	...	...	...	...
,,		Waterford	1·50	— ·73	·35	4	9	63·0	20‖	34·0	23	...	...
,,		Killaloe	1·56	— ·57	·52	21	9	75·0	13	28·5	13	...	...
XXI.		Portarlington	·71	— 1·31	·22	7	13	69·5	20	31·0	23	4	...
,,		Monkstown, Dublin	·86	— ·78	·33	26	9	...	...	...	...	...	...
XXII.		Galway	2·19	...	·43	21	9	71·0	19†	32·0	14	1	...
,,		Ballyshannon	1·23	...	·50	26	11	...	...	...	...	...	...
XXIII		Waringstown	·56	...	·39	6	6	75·0	20	28·0	6	9	...
,,		Edenfel (Omagh)	·63	...	·16	6	11	70·0	20	28·0	22	10	19
													...

* And 28, 30. † 21. ‡ 20. § 22. ‖ 29. ¶ 23

+Shows that the fall was above the average; —that it was below it.

METEOROLOGICAL NOTES ON APRIL.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

LINTON.—Some useful R in the second week, otherwise the month a very dry, bright, sunny one, contrasting strongly with the three preceding ones. Frost on the 8th, 14th, 24th, 25th and 26th. Winds mostly N.E.; the heaviest rainfall ·75 on the 9th, being from that direction; bar. usually high. On the whole a fine, bright month, but R much wanted, the ground being very dry, and fears for the future entertained. Cuckoo heard on 15th, being about the average time; nightingale not heard till the 19th, which is late.

SELBORNE.—Vegetation in fields and gardens much retarded by cold and drought. Total rainfall in 3 months, 5·24 in.; frequent frosts on the grass. Swallow first seen on 18th, and cuckoo heard on 19th.

BANBURY.—High wind on the mornings of the 5th and 9th, and night of 8th.

CULFORD.—Another month of dry, cold weather, with a prevalence of E. winds during 20 days; the rainfall has been little more than 1 in., and fell on seven days. Mean temp. of the month 46°·5. Swallows first seen on 19th; nightingale first heard on 21st, and the cuckoo on the 26th.

BRIDPORT.—A very dry month, and vegetation backward, owing to the cold nights and hot days. Cuckoo first heard on 15th; young thrushes fledged on 19th.

BODMIN.—Average bar. 30·01; mean temp. 52°·1.

HAUGHTON HALL.—Another dry, cold month, the most so since 1844, when only ·37 in. of R fell. It was mild till the 5th, when the temp. sank with a sudden fall of bar, bringing slight R for 5 days, with a S.W. wind; cold then continued from N. and N.E., with the exception of four strangely warm days (18th to 21st), till the 22nd, on which day R fell with sleet; after that time to the close the wind varied from N.W. to S.W. The bar., with the exception of the fall above-mentioned, was remarkably steady throughout. Dense fog on the 17th. Vegetation at least a fortnight late; hawthorn not in leaf till the 18th; blackthorn blossom, 19th; wild cherry on 21st. A few sand martins came on the 7th; swallows on 15th; a tortoiseshell butterfly on the 18th; throstle fledged on 26th; cuckoo heard on 23rd.

ORLETON.—Very cold, with a strong wind and a cloudy sky, excepting two or three days, till the 12th; the sky then cleared, and from 13th to 21st there was scarcely a cloud visible, but there was much haze. On the 19th the ther. rose to 70°·7, and on the 20th to 72°·8 in the shade; the remainder of the month was fine, dry, and pleasant. Mean temp. about 2¼° below the average for the month, and was lower than that of any April since 1861. No T heard or L seen. Cuckoo first heard on 17th, and generally heard on 20th; chiff chaff first seen on 21st; damsons in full blossom on 19th, and early cherries on 23rd.

LEICESTER.—R fell each day from 3rd to 10th, after which none fell, with exception of ·05 in. on the 20th. Very fine and warm from the 15th to 20th; mean temp. of month 47°·4. Although there were only two nights with the temp. below 32°·0, there were 16 below 40°·0; bar. high and steady.

BOSTON.—The weather generally dry and cold, with N.E. winds; mean temp. 2° below the average of the last 11 years. Rainfall ·43, the least known in April for upwards of 20 years (the next smallest being in April last year). Since September last, the commencement of the season calculated on for storage purposes, there is a deficiency from the average of ·68. The prevailing winds have been N.E., the winds from this quarter over the average during the last three months. The effect of the Polar winds on the temp. was strikingly shown on the 21st, when, owing to a change in the direction of the wind, the ther. in the sun fell in the course of two hours from 85° to 54°. The thorn in leaf about the 25th; Cuckoo heard on 27th. Owing to the dry weather and cold, frosty nights the pastures are very backward and keeping scarce, but the corn crops all look exceedingly well, and it has been a splended season for working the land. The reports as to the fruit so far appear to be very favourable.

GRIMSBY.—Month remarkably dry; pastures woefully bare; farmers hard set to find food for sheep and cattle. Bar. very steady for the most part; season very backward; good promise of fruit; peach beginning to blossom on 1st; cowslip on 24th; cuckoo flower on 30th; swallow seen on 19th; cuckoo heard 23rd willow warbler arrived on 25th. High tide in the Humber at night on 7th. Temp. fell from 63° to 48° in the forenoon of the 21st.

ARNCLIFFE.—An unusually dry month; vegetation as forward as usual.

NORTH SHIELDS.—TS on 5th.

SEATHWAITE.—No R from the 5th to the close, except on the 26th.

WALES.

HAVERFORDWEST.—A cold month; fine weather for out-door work; splendid seed time. Very hot from 19th to 21st; 22nd a most winterly day, R mixed with sleet, and temp of 24 hours only 34°.

LLANDUDNO.—A dry and most enjoyable month, with much sunshine, 24 days on which no R fell. Swallows seen on the 21st, and the cuckoo on 24th. Difference between dry and wet at 2 p.m. on 19th, 14°; at 10 a.m. on 20th, 15°.

SCOTLAND.

DUMFRIES.—Another very dry month, the rainfall being chiefly at the commencement. The prevailing wind was E. and N.E., but the mean temp. was pretty high, 46°·29, exactly the same as last year, and 7°·5 above that of last month. Gale from S.W. on night of 4th; sleety showers and S on the hills on 7th.

SILVERBUT HALL, HAWICK.—A dry month, with cold E. winds. There is a fine promising appearance of fruit, the trees in orchards, gardens, and on walls are literally covered with blossoms. The country, though now looking very lovely, shows a want of R.

ANNANHILL.—Bar. pressure less than last month, and mean temp. 5°·8 higher. Rainfall deficient; prevailing winds W. and S.W.; strong S.W. gale on 3rd; gales also on the nights of 2nd and 4th, the rest of the month calm. H fell on the 6th, and much frost registered during the month. Ozone better developed, the tests recording the max. on two occasions under S.W. winds. Several of the evenings cloudless; the day skies mostly cloudy.

CASTLE TOWARD.—Notwithstanding the stormy winter and backward spring, with all the evil forebodings, agricultural operations have passed harmlessly and satisfactorily; work well advanced; pastures, and grass for Hay, look well; turnips here slice plentiful; great promise of fruit. As a whole the month has been all that could be desired; the 18th, 19th and 20th were very warm, the ther. ranging from 66° to 67°; but some of the mornings were cold, and on the morning of the 22nd we had hoar frost, and temp. of 24°. Butterflies were seen during the second half of the month, as well as young blackbirds.

BRAEMAR.—Fog on 14th, 15th, and 16th. Though the frost has been rather severe the month has been a most favourable one for agricultural and horticultural purposes. Lunar halo on 16th.

ABERDEEN.—H on 6th, 23rd with S and heavy, with T and L at 2.15 p.m. on 27th; bar. pressure and temp. above the average, rainfall rather below it. A month of very fine, dry weather; the temp., though on the whole high, has been marked by sudden changes.

LOCH BROOM.—The most beautiful and favourable April ever seen in this remote region; every thing is in a state of forwardness, and the prospect for the future is most encouraging—man and beast, things animate and inanimate, all rejoice in this smiling weather.

PORTREE.—A very fine month for all out-door work—the farmers never had better weather for laying down all kinds of crops; vegetation is making rapid progress; trees and shrubs bitten by the March frost are now fast recovering from its effects. The young lambs are thriving well and appear to be very numerous.

CULLODEN.—Fog very frequent from 10th to 19th. H on 6th. Horse chesnut in leaf on 10th; pear, cherry, gooseberry and currant in bloom; and plane in

leaf on 12th; larch on 15th; birch on 19th; and lime on 28th. Barley sown on 12th; plums in flower on 20th; and elm on 26th.

SANDWICK.—April was remarkably fine, the weather for a considerable time being as warm and pleasant as Midsummer. The rainfall was raised above the average by the heavy fall on the 28th. Aurora was seen only on one night (7th), and now the nights are too light to allow of their being seen till August.

IRELAND.

DARRYNANE.—Early part and last few days wet; from 3rd to 7th the fall of R was 2·32, no more fell till the 25th, the interval being fine and bright with easterly winds. The R at the end of the month was much wanted, as vegetation was very backward. Cuckoo heard on 26th, and corncrake on 28th.

MONKSTOWN.—An eminently dry April, resembling those of 1864, 1870, and 1873; dry weather prevailed from the 8th to the 19th; hazy, with bright sun and cold easterly winds.

BALLYSHANNON.—The month has been one of exceptional dryness, R falling on 11 days only; this has retarded vegetation, which, however, has now actively commenced, and the season promises to be very favourable to the farmers. The temp. has been more like that of June than April.

WARINGSTOWN.—Very dry; crops looking well, though in want of R.

SUPPLEMENTARY TABLE OF RAINFALL IN APRIL, 1875.

[For the Counties, Divisions, Latitudes, and Longitudes of these Stations, see Met. Mag., Vol. X., p. 28.]

Station.	Total Rain.	Station.	Total Rain.
	in.		in.
Acol	1·33	Gainford	·84
Hailsham	1·10	Shap	1·55
Strathfield Turgiss	1·41	Llanfrechfa	3·15
Addington	1·96	Castle Malgwyn	2·07
Oxford	1·24	Heyope	...
Cambridge	1·07	Melrose	·72
Sheering	1·39	Cessnock, Glasgow	1·29
Ipswich	1·14	Gruinart	1·68
Diss	1·02	Keith	1·38
Swaffham	·88	Strathconan	2·57
Compton Bassett	1·51	Springfield, Tain	1·03
Hessary Tor, Dartmoor	3·03	Skibbereen	1·53
Teignmouth	1·55	Fermoy	1·92
Torrington	2·30	Kilrush	1·67
Falmouth	...	Kilkenny	·90
Taunton	1·56	Kilsallaghan	·91
Cheadle	·43	Twyford, Athlone	1·35
Ashby de la Zouch	·82	Ballinasloe	...
Coston, Melton Mowbray	1·18	Kylemore	3·76
Bucknall	·48	Bangor	2·12
Mansfield	·91	Carrick on Shannon	1·22
Walton, near Liverpool	·61	Warrenpoint	·52
Broughton-in-Furness	1·81	Bushmills	·43
Stanley, Wakefield	·48		

SYMONS'S
MONTHLY
METEOROLOGICAL MAGAZINE.

CXIII.] JUNE, 1875. [PRICE FOURPENCE or 5s. per ann. post free,

CONFERENCES AND CONGRESSES.*

IT is admittedly possible to have too much of a good thing.

Have we had too many International Meteorological meetings?

Have the results equalled the expectations of all concerned?

Has Meteorology been advanced proportionately to the sums expended in travelling and other accessories?

We yield to none in our appreciation of the advantages of the freest intercourse between the leading Meteorlogists of all countries. Whatever may be the verdict as to the public benefit arising from the extensive migrations which have lately been so fashionable, there can be no doubt that they must have considerably enlarged the views of those who have participated in them—although probably not to the extent which would have been the case had the delegates not cut themselves out thrice the work which could be properly accomplished. Still, as we have already said, the intercourse of the leading men of both hemispheres, must have been beneficial to all.

The personal benefit of the directors is of course a distinct national advantage, because the more able the director, the better the work which the nation who pays for it will obtain from him and from his office. Here, then, without further preface, we come upon a fact which must be held as in part an affirmative answer to our third question.

It is impossible to give categorical replies to the questions with which this article commences—at any rate, we cannot give them. We can only record our wish that all who take an interest in the question would buy these blue books and study them for themselves. We have

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* *Report on Weather Telegraphy and Storm Warnings.* Presented to the Meteorological Congress at Vienna, by a Committee appointed at the Leipzig Conference. Published by order of the Meteorological Committee. London: 8vo. Stanford, 1874.

Bericht über Wetter-Telegraphie und Sturmwarnungen, &c. [The German edition of the above.] Redigirt von Dr. G. v. BOGUSLAWSKI. Berlin: 8vo. Mittler u. Sohn, 1874.

Report of the Proceedings of the Conference on Maritime Meteorology held in London, 1874. Published by order of the Meteorological Committee. London: 8vo. Stanford, 1875.

Report of the Permanent Committee of the First International Meteorological Congress at Vienna for the year 1874. Published by order of the Meteorological Committee. London: 8vo. Stanford, 1875.

done so with the strongest desire to be convinced that the combined skill of all the able men who have devoted their time to these meetings has succeeded in giving to Meteorology an impulse proportional to their efforts; but at present we must confess that we are waiting to be convinced. The refrain throughout seems to be—improve your stations, start many new ones, publish masses of statistics. Surely there is something higher, nobler, and more useful—though less glittering—than this! Has no one a word to say for a combined attack on the great problems of Meteorology, for ascertaining what we do know and what we do not know, and discussing existing data, instead of "adding millions of useless observations to the millions which already exist." We had perhaps, in order to avoid misconception, better here state distinctly that we are far from denying the utility of either establishing new stations or publishing the results; on the contrary, we approve of both; but we protest against work such as this being regarded as the aim and end of official meteorology. It is work which requires but a modicum of brains, and which is essentially adapted for the junior assistants of the various offices. We trust that in future conferences higher class work will be discussed.

We find no fault with the rules suggested, in the works now before us. We do not notice anything seriously wrong, but we do regret to see nineteen-twentieths of the thought of the conferences devoted to the observational, and but one-twentieth to what may be called the thinking power in Meteorology. Of course we shall be told that we are mistaken, that this article is unduly severe, that none but perfect observations are worth working up, and that therefore it is a necessary pre-requisite to establish good and uniform stations. Suppose it were so—the first conference met in 1872, we are now near the middle of 1875, are the stations yet in operation, and the instruments, &c., identical? And even if this question can be answered in the affirmative, we are not much more forward, for we must follow it by asking what steps have been taken by those entrusted with national resources to attack the difficult problems of Meteorology? such as have been attacked by private or semi-private observers. We need only mention the names of Loomis, Ley, Buchan, Blandford, and Hildebrandsson to indicate to thinking men the class of work which appears to us to have been almost ignored by the delegates and correspondents of the Conferences. The various meetings which have been held have been generally confined to gentlemen holding Government appointments, to the Directors of various national systems, and the works before us report their proceedings. We are sorry to see that men of such great ability—as many of them are—have spent their time upon discussing points upon many of which we cannot understand there being two opinions, and upon others which a good optician could have decided in half-a-minute.

Happily for themselves, nearly all the delegates are known for work of high quality. We have, therefore, confidence in the future, in spite of the depressing influence which, rightly or wrongly, the reports have exercised upon ourselves.

THE ROYAL OBSERVATORY, GREENWICH.

THE return of "Visitation-day," and the publication of the annual report of the Astronomer-Royal, render appropriate a few words respecting this national establishment, or rather one portion of it, for it is, and always has been, essentially and primarily an astronomical establishment, and with the astronomical arrangements we are here not concerned. We therefore select those matters which relate to meteorology. Under the head of Library we find the two following paragraphs:—

"The number of books has been considerably increased by presents from foreign countries; partly, I think, in consequence of the facilities now given by foreign book post; partly from the enormous activity in the publication of unreduced meteorological observations in the utmost detail. I doubt whether the value of the library is much increased by the works last mentioned."

"It seems doubtful whether the mass of unbound pamphlets is worth preservation."

We are very glad to find that the views urged in the first article in this magazine have evidently the support of Sir George Airy; in fact, he goes further than we do. We do not question the utility of printing observations *in extenso*, but we do lament the rarity of high-class brain work.

We trust that the Astronomer Royal will not allow the "mass of unbound pamphlets" to be destroyed without submitting them to scrutiny. If the Observatory Library does not need them, let them be sorted into heaps, astronomical, meteorological, &c., and forwarded to the societies for their scrutiny; but never let it be said that England has treated the mass as waste paper. If they are to be sold, there are many scientific men who would be glad to preserve them from being re-converted into pulp, which will probably be their destiny if sent to H.M. Stationery Office.

"It will be remembered by the Visitors that an extensive reduction of the Photographic Meteorological Records from 1848 to 1868 was commenced a few years ago. Among the infinite number of ways in which the different phenomena of meteorology may be combined, I selected for present examination the hourly photographic readings of the Dry and Wet Thermometers, arranged to exhibit diurnal inequality of those two instruments; as grouped by months, as grouped by high and low temperatures, as grouped by high and low barometer, as grouped by clear and cloudy skies, and as grouped by directions of the wind. This work is completed, and the abstracts for press are only waiting my examination. To this was added a deduction of the diurnal inequalities of the barometer from the hourly photographic readings from 1854 to 1873; this work is about half done. A limited discussion of the readings of the deep-sunk thermometers from 1846 to 1873 is completed."

The importance of this reduction cannot be denied. Although the Greenwich thermograph was the first that was made, we believe that no subsequent one is better. This may seem a harsh statement, but we think that it is very objectionable to have (as is now the fashion) the thermograph bulbs within 1 ft. or 1 ft. 6 in. of a brick or stone wall.

Mr. Glaisher having resigned at the end of the year 1874, Mr. Ellis was appointed Superintendent of the Magnetical and Meteorological Department, Mr. Nash remaining as Assistant.

The report concludes with an interesting survey of the work of the Observatory during the forty years that it has been under the direction of Sir George Airy, from which we must make a few extracts.

"The Report which I have now read is the fortieth of its class which I have had the honor to lay before the Board of Visitors. During the time to which they apply, the constitution of the Observatory, personal and material, has been greatly changed. Only one Member of the Board of Visitors, I believe, remains as witness of my first proceedings. There is not now a single Assistant, or a single instrument in use (for even Shuckburgh's Equatoreal is not employed as a graduated instrument) of those which formed the Establishment of 1835. The contemplation of this long period and of these changes induces me to look both backward and forward on the objects of the Observatory and the mode of carrying them out."

"The subject of Meteorology, which has been followed for many years, is scarcely connected with the two great heads of Astronomy and Navigation, and hardly deserves the name of a science. It is, however, in great popular request.

"Mechanical self-registration of some meteorological phænomena was introduced by me shortly after the commencement of my residence."

"Turning now from the past to the future, I see little in which I could suggest any change. If it should ever be necessary to make any reduction, I should propose to withdraw Meteorology, Photoheliography, and Spectroscopy; not as unimportant in themselves, or as ill-fitted to the discipline of the Observatory, but as the least connected with the fundamental idea of our establishment. In the nature of addition, I will indicate one practical point. I much desire to see the system of time-signals extended, by clocks or daily signals, to various parts of our great cities and our dockyards, and above all by hourly signals on the Start Point, which I believe would be the greatest of all benefits to nautical chronometry.

"Should any extension of our scientific work ever be contemplated, I would remark that the Observatory is not the place for new physical investigations. It is well adapted for following out any which, originating with private investigators, have been reduced to laws susceptible of verification by daily observation.

"The National Observatory will, I trust, always remain on the site where it was first planted, and which early acquired the name of 'Flamsteed Hill.' There are some inconveniences in the position, arising principally from the limited extent of the hill, but they are, in my opinion, very far overbalanced by its advantages."

Although we have always recognized the subordinate position of meteorology at the Royal Observatory, and consider the arrangements faulty in many respects, we should extremely regret the interruption of the existing series of eye observations. They are far from perfect, but they are unequalled as regards questions of secular change. One youth, as observer and computer, would be easily able to continue the eye observations, which we hold should never be altered or abandoned. We should be sorry to see the Meteorological Department reduced, and protest in the strongest terms against its ever being annihilated.

ON THE TEMPERATURE OF THE WINTER OF 1874-75.

By M. E. QUETELET.

[Translated from the *Bulletin de l'Académie Royale de Belgique, Avril*, 1875.]

THE past winter has presented some peculiarities worthy of brief notice. The mean temperature of September and October, 1874, were

about 2° above the average; November, on the other hand, was rather cool, December was very cold, January, on the contrary, was hot, February very cold, March rather so. The minimum of the winter, 8°·8, occurred on December 30th, and had been preceded by twelve days of uninterrupted frost; two days after this severe cold came suddenly the thaw, which was followed by the long warm period during January. In the forty years records of Brussels Observatory there is only one winter (1859-60) which presents the succession, December very cold, January very hot, February very cold. In order to compare readily the march of temperature during these two winters, I give in the following table the mean monthly temperatures for the two years, and append thereto the mean values given by our forty year series:—

	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May
Winter of 1859-60	58·8	53·6	40·5	33·1	40·3	33·3	39·2	45·0	57·2
,, ,, 1874-75	60·1	52·7	40·6	32·5	40·5	32·7	39·2	—	—
Average 40 years	58·3	50·7	42·3	37·6	35·6	38·1	41·4	48·2	55·6

The agreement of the monthly mean temperatures during the two winters (October to March) is remarkable. One might be tempted to think that this agreement may continue, but we must not forget that the parallelism fails as regards pressure, rain, &c., and therefore we must not regard the seasons as directly comparable. However that may be, if the agreement in temperature continues, we shall have a rather colder April and warmer May than usual.

GREAT VARIATION OF SHADE TEMPERATURE, APRIL 21ST.

To the Editor of the Meteorological Magazine.

SIR,—When I made the observation about the sudden change of wind on the 21st April, I might have added a few particulars which would have helped to support the observations of others. The 19th and 20th were fine warm days, the maximum temperatures being 70° and 72°; the mimima were low, 32° and 37°. The morning of the 21st was very fine; at 9 a.m. the dry bulb thermometer was 63°, the wet bulb 54°; between twelve and one o'clock 65° was reached, the wind blowing very lightly from the west. I did not observe any change in the direction until 3 p.m., when I was suddenly surprised by a great rushing noise in the N.E., something like the herald of a heavy hailstorm. The change was, I may say, immediate from comparative calm to a rough high wind, and with the wind came the cold. During the night of the 21st the thermometer fell to 36°, and on the 22nd 46° was the maximum, and at 9 a.m. on the 22nd the thermometer stood at 39°, or 26° lower than on the previous day.

I am, Sir, yours obediently,

JOHN MATHISON.

Addington, 18th May, 1875.

To the Editor of the Meteorological Magazine.

SIR,—It has occurred to me that the following few particulars of the memorable 21st April may be interesting to you. 21st April, brilliant and clear till noon, cloudy after; very slight drizzling rain at times after 3 p.m. Max. temperature (of the day and month) 64° at noon, min. temperature 32° (early a.m.)

	Dry Bulb		Wet Bulb
At 10.0 a.m.	61·6	...	51·1
,, noon	64·0	...	52·0
,, 0.30 p.m.	57·0	...	49·0
,, 1. 0 p.m.	54·0	...	50·0
,, 2. 0 p.m.	43·8	...	41·3
,, 3. 0 p.m.	41·0	...	41·0
,, 6. 0 p.m.	38·0	...	38·0
,, 8. 0 p.m.	36·0	...	—
,,10. 0 p.m.	34·0	...	33·0

Wind S.E. in the morning, brisk from 10 a.m. to noon; N. strong till 8 p.m., then grew calm. No appreciable rainfall.

I am, Sir, your obedient servant,

F. R. HAWKES-MASON.

White House, Wereham, Brandon, 7th June, 1875.

SUPPLEMENTARY TABLE OF RAINFALL IN MAY, 1875.

[For the Counties, Divisions, Latitudes, and Longitudes of these Stations, see Met. Mag., Vol. X., p. 28.]

Station.	Total Rain.	Station.	Total Rain.
	in.		in.
Acol	1·78	Gainford	1·06
Hailsham	·59	Shap	2·71
Strathfield Turgiss	1·44	Llanfrechfa	4·05
Addington.....	2·36	Castle Malgwyn	2·50
Oxford	1·77	Heyope	2·76
Cambridge.....	1·98	Melrose	1·55
Sheering	1·47	Cessnock, Glasgow	1·14
Ipswich	3·38	Gruinart	2·30
Diss	2·18	Keith	1·44
Swaffham	1·13	Strathconan	3·44
Compton Bassett	3·04	Springfield, Tain	1·15
Hessary Tor, Dartmoor..	5·28	Skibbereen	3·02
Teignmouth	2·55	Fermoy	2·92
Torrington..... ..	3·14	Kilrush	1·91
Trevarrick, St. Austell..	3·19	Kilkenny	1·52
Taunton.....	2·57	Kilsallaghan	1·72
Cheadle	1·63	Twyford, Athlone	2·36
Ashby de la Zouch	2·02	Ballinasloe.....	...
Coston, Melton Mowbray	1·22	Kylemore	6·00
Bucknall	1·37	Bangor	4·11
Mansfield	1·52	Carrick on Shannon.....	2·82
Walton, near Liverpool..	2·21	Warrenpoint	2·15
Broughton-in-Furness ..	3·25	Bushmills	2·03
Stanley, Wakefield	1·41		

VAN RYSSELBERGHE'S METEOROGRAPH.

We learn from *L'Echo de l'Ostende* of May 30th, that at the meeting of the Royal Academy of Belgium, on May 11th, Prof. Van Ryssel-berghe exhibited the complete Meteorograph which is to be erected at Ostend. It is said to have been constructed with "rare precision" by Schubart, of Gand, and it engraves on a single plate the curves of (1) Mecurial barometer, (2 and 3) dry and wet bulb thermometers, (4) hair hygrometer, (5 and 6) wind's direction and force, (7) rain gauge, (8) tide gauge. The last will, we understand, be at some distance from the rest of the apparatus.

CUCKOO FIRST HEARD AT LINTON PARK ON THE DAYS MENTIONED BELOW.

1854	April 15	1860	April 27	1866	April 11	1871	April 10
1855	,, 18	1861	,, 20	1867	,, 18	1872	,, 12
1856	no record	1862	no record	1868	,, 21	1873	,, 13
1857	April 17	1863	April 13	1869	,, 10	1874	,, 20
1858	,, 15	1864	,, 16	1870	,, 16	1875	,, 15
1859	,, 19	1865	,, 11				

J. Robson.

REVIEWS.

The Meteorology of Sussex. By F. E. Sawyer. 8vo., 54 pages. [Reprint of a series of articles from the *Brighton Herald.*]

This is a capital little pamphlet, which contains an unequalled store of Meteorological data respecting the county, very systematically arranged and pleasantly written. The articles seem almost to justify the author's rather strong statement—"they present in a collected form all that has been written or observed respecting the climate of this county up to the present time." Of course Mr. Sawyer meant to write in a collected [and abridged] form, and, thus altered, the paragraph is almost correct. The collection of notes and records is remarkably good, and the gossiping bibliography at the end of the work is very useful. We may as well give the author another title to add to his list. *Eastbourne, and the advantages which it possesses as a resort for Invalids:* by W. Abbotts Smith, M.D., and C. C. Hayman, M.D. London, Stanford, 1861, post 8vo.

Climatologie de la ville de Fécamp, ou résumé général des observations météorologiques faites en cette ville de 1863 *à* 1872, Par. E. Marchand, Pharmacien, &c. Le Havre: Lepelletier, 1874. 8vo.

(*Continued from page* 58.)

M. Marchand has worked up his results in praiseworthy detail, and among other data gives the mean temperature of every day in the year. And not only so, but he gives the similar values for Paris (as

published by Marie-Davy) and for Lyons. We must, of course, refer our readers to the work itself for the complete tables, but we give the values for the first fortnight in May, adding those for Greenwich:—

	Mean temperature of each day from May 1st to 16th.				Departures from normal mean daily temperature.			
	Fécamp, 1853-72.	Lyons, 1851-65.	Paris, 1806-70.	Greenwich 1814-63.	Fécamp.	Lyons.	Paris.	Greenwich
1	50·0	53·6	53·8	50·1	— ·1	— ·9	— ·6	+ ·3
2	49·8	54·7	55·0	51·1	— ·5	— ·2	+ ·4	+1·1
3	51·1	56·7	56·1	50·5	+ ·6	+1·5	+1·3	+ ·3
4	50·2	55·6	55·9	51·2	— ·5	·0	+ ·8	+ ·7
5	50·4	54·7	55·6	51·5	— ·4	—1·3	+ ·3	+ ·8
6	51·4	54·7	55·8	51·6	+ ·4	—1·7	+ ·3	+ ·7
7	52·2	57·0	56·8	51·9	+1·0	+ ·3	+1·1	+ ·8
8	51·3	58·8	56·7	51·6	— ·1	+1·7	+ ·7	+ ·3
9	51·1	58·6	56·5	50·8	— ·5	+1·1	+ ·3	— ·7
10	52·3	59·2	56·1	50·8	+ ·5	+1·3	— ·4	— ·9
11	52·7	59·9	56·7	51·6	+ ·7	+1·6	·0	— ·3
12	51·8	57·9	56·5	51·4	— ·3	— ·8	— ·4	— ·8
13	51·8	58·8	56·1	51·2	— ·5	— ·3	—1·1	—1·2
14	52·7	58·8	55·9	50·9	+ ·2	— ·7	—1·5	—1·7
15	52·9	60·3	56·5	52·3	+ ·2	+ ·4	—1·1	— ·5
16	52·5	58·3	57·0	53·5	— ·4	—1·9	— ·8	+ ·5
17	53·8	60·1	58·3	54·0	+ ·7	— ·5	+ ·3	+ ·8

We are not prepared to defend the absolute accuracy of the method we have adopted for determining the departures, but we believe it, though intricate, to be correct, and it certainly brings out the feature which we wished to illustrate—namely, the low temperature May 9th to 15th. If our calculations are correct, the departure table proves that the deficiency is felt first at Greenwich where it becomes greatest, that it occurs one day later at Paris, and three days later at Fécamp and Lyons, but at neither of these is it so marked as at the first two.

Respecting the rainfall, M. Marchand gives the total yeraly fall, which (converted) is as follows:—

	in.		in.
1853.....	31·61	1863.....	27·68
1854.....	29·60	1864.....	24·07
1855.....	27·23	1865.....	31·80
1856.....	30·03	1866.....	38·89
1857..... ..	29·08	1867.....	36·85
1858..... ...	30·89	1868.....	27·93
1859.....	39·63	1869.....	32·21
1860.....	45·79	1870.....	30·53
1861.....	26·36	1871.....	28·40
1862.....	30·88	1872.....	43·60
Mean...	32·11	Mean ..	32·20

Upon this table M. Marchand very justly remarks that in the first place it must not be assumed that the singularly close agreement between the mean rainfall in the two decades implies that that impor-

tant element necessarily lies between those values, and he proves this by showing that the mean of the ten years 1862-71 was only 30·93 in., whereas that of the decade 1858-67 was 33·28 in. In earlier parts of the work M. Marchand has shown that the second decade was warmer, the wind more southerly and stronger than the first; he therefore compares the seasonal distribution of rain, and finds the following marked difference:—

	First Period.	Second Period	Difference.
Spring	6·93 in. ...	6·46 in. ...	—0·47 in.
Summer	7·64 ...	6·54 ...	—1·10
Autumn	10·71 ...	10·91 ...	+ ·20
Winter	6·85 ...	8·31 ...	+1·46

The following remarks as to a question of periodicity may be worthy of extraction:—

"I have in my first memoir called attention to the inundations of 1824, 1842, and 1860, as appearing to indicate a return of these disastrous phenomena at the expiration of each period of 18 years. The future will demonstrate the value of this remark. I think, however, that I ought to mention here a 17th century fact, which within a trifle agrees with the above rule. According to a petition signed by a M. Corbière, and by a M. Le Huillier, curé de St. Fromond, 'on the 18th of September, 1679, the waters inundated the houses to a depth of from 4 to 5 feet, they destroyed the merchandize, and washed away the gardens and placed many persons in peril of their lives.' According to another account the inundation occurred on a Sunday, during service in the church of St. Fromond; the office had to be suspended, and the faithful hastened from the edifice for safety. This church was situated on the steep land between Rue du Bail and Rue Jaques Huet, and near the right bank of the large Rue de l'Inondation, which was opened in 1848 to prevent the recurrence of such disasters as occurred in 1824 and 1842.

Ah, well! between 1679 and 1824, each of which were characterized by great accumulations of water in the Place du Bail, there elapsed almost exactly eight periods of 18 years each. This fact is worthy of notice."

This subject certainly requires further evidence; but before leaving it we are tempted to place at M. Marchand's service the title of an English book which would interest him, "*A cycle of eighteen years in the seasons of Britain, deduced from Meteorological observations*, 1824-1841, by Luke Howard., F.R.S.; 8vo., Ridgway, London, 1842."

One of the quaintest ideas in M. Marchand's work, and almost the only one which we cannot yet accept, is that electric phenomena, hail, storms, and rain are excessively frequent during the week which has Ascension Day for its middle day. This leads the author to discuss the influence of the moon on the weather. Into this desperate subject we shall not plunge, the importance of the differences which he has proved seems to us very slight, for instance that between the mean daily temperature of two quarters* is 0°·007 F. It is somewhat more appreciable between the syzigies, but even then it only just exceeds 0°·1 F., and is therefore in both cases quite imperceptible to the feelings, and of no practical importance.

Before quitting this work, we must pay tribute of the highest praise

* Or rather two halves, for M. Marchand divides the lunation into (1) From the last quarter to the first quarter (moon dark), and (2) From the first quarter to the last (moon light).

to M. Marchand for his great care in reading the proofs We know a little of the rarity of accurately-printed tables, and of the care requisite to secure even moderate success; but though M. Marchand's book is crammed with closely-printed tables, many of which we have checked, we have at present only detected a single misprint—viz. on p. 34, in the last line of the last column of the table, 32°·4 should be 32°·7.

Report of the Kew Committee for the year ending October 31*st*, 1874.

THANKS to Mr. Gassiot's princely liberality this establishment is efficiently maintained, and the above report shows that somewhat more than the average amount of work has been accomplished during the year. Two special sets of experiments are mentioned, but as the results are not even indicated we suppose we must wait for their appearance in some other form. The paragraphs to which we refer are the following:

"The daily record of temperature from thermometers at different elevations on the Pagoda, in the Royal Gardens, Kew, at the expense of the Meteorological Committee, was continued up to August, when it was interrupted, to be resumed during the winter months."

"In the last report mention was made of certain experiments in progress, with respect to the testing of Anemometers. A piece of ground having been rented in the Park was not nearly sufficiently open to afford facilities for testing the instruments at any but very low velocities, and not very satisfactorily even in such cases. Application was therefore made to the Secretary of the Crystal Palace Company for permission to employ a rotary machine driven by steam power, so as to be able to vary the velocities at pleasure. Consent having been most freely given, the experiments were commenced, and the instruments tested at various velocities up to about 30 miles an hour, the highest attainable by the apparatus. The investigations were interrupted during the summer, and will be resumed on a future occasion. It is hoped that by this method of artificial rotation, which was that employed by Smeaton in his experiments on windmill sails, more satisfactory results will be attained than it is otherwise possible to get. The expense of the experiments has been defrayed by a vote of the Government Grant Fund."

Repertorium für Meteorologie herausgegeben von der Kaiserlichen Akademie der Wissenchaften redigirt von DR. H. WILD. Band IV., Heft 1., 4to. St. Petersburgh, 1874.

THIS part contains the following six papers:—

(1). WILD, H. Additional Supplement to the Instructions for Meteorological Stations.
(2). MIELBERG, J. Magnetic Declination at St. Petersburgh.
(3). FRITSCHE, H. Geographical, Magnetical and Hypsometric Observations at 59 Stations on the route from Pekin, through Eastern Mongolia, Nertschinsk, Irkutzk, Barnaul, Ekaterinburg and Perm to St. Petersburgh.
(4). KOPPEN, Dr. On the dependence of the Climatic character of the Winds on their origin.
(5). DOHRANT, F. On the estimation of Anemometer Constants.
(6). RIKATCHEFF, M. The distribution of Atmospheric pressure in European Russia.

We select the last, for notice on the present occasion, as probably of most general interest, but that of M. Dohrant is also well worthy of consideration.

M. Rikatcheff's paper is the best of its class that has appeared for many years. It immediately challenges comparison with Mr. Buchan's paper in the *Trans. Roy. Soc.*, Edinburgh, and surpasses it in accuracy as much as Mr. Buchan's does M. Rikatcheff's in extent, and number of stations. This comparison would naturally occur to any one conversant with the subject, but it is especially forced upon our notice by the rather severe manner in which M. Rikatcheff deals with Mr. Buchan's tables respecting the barometric pressure in Russia. Most likely Mr. Buchan's figures are not right, but M. Rikatcheff seems to overlook the difficulty which all but Russians would have in ascertaining with precision the facts of each case, and to forget entirely that his intimate acquaintance therewith is largely due to the special facilities which his appointment gives him.

After a comparatively brief introduction, M. Rikatcheff proceeds to give interesting and useful data respecting each station, and then he inserts a table of mean annual pressure at about 60 stations. These values are the basis of his yearly mean isobarometric chart, in reference to the formation of which M. Rikatcheff truly suggests that the most exact mode of constructing such a chart, would be to compute by the method of least squares the co-efficients depending on the latitude and longitude, and thence the place of each isobar. He, however, rightly points out that at present the observations are neither sufficiently accurate, nor made at stations sufficiently close together to render the adoption of this plan advisable. Of the Russian stations the lowest mean (seven years) annual pressure is 29·796 in. at Kem, in lat. 64°57′ N. and lon. 34°39′ E., and the greatest is 30·071 in. at Orenbourg, in lat. 51°49′ N. and lon. 55°6′ E.

This table is followed by data respecting other stations, and the mode by which the returns of stations in the first table are used for checking and completing those in the subsequent ones.

The tables of mean monthly pressure appear to be carefully worked out, and are followed by remarks upon them, and upon the monthly isobaric charts drawn from them. Finally the memoir ends with the following summary.

(1) We require particularly the altitude of the stations of Bogoslowski, Catherinebourg, Zlatooust, and Lougan, and barometric observations for at least ten years at many stations in N., E. and central Russia, but their precise altitude must be determined.

(2) The isobaric charts are probably true to 0·040 in. in Eastern, and to 0·010 in. in Western Russia.

(3) The distribution of temperature and of vapour in the various months of the year, explains the high atmospheric pressure in Asia during the winter and its displacement towards the Atlantic in summer.

(4) Although these general causes are inadequate to explain the small barometric pressure in the N. of Europe, where the pressure of dry air is greater than in the hot southern countries, we have thought that it may be explained by the squalls and cyclones which, formed over

the gulf stream and on the W. of Europe, travel northeastward. As to the minimum which we notice at Christiansund we attribute it to the great quantity of rain which falls in that part of Norway.

(5) The contours of the continent and the mountains appear also to exercise an influence over the configuration of the isobars.

Essai sur les courants supérieurs de l'Atmosphère dans leur relation aux lignes isobarométriques. Par H. HILDEBRAND HILDEBRANDSSON (Présenté à la Société Royale des Sciences de Upsal, le 28 Novembre, 1874.) Upsal: Berling, 1875. Folio.

THIS is a first attempt at determining the motion of the upper currents of the atmosphere by comparing records of the direction of the motion of those clouds (the cirri) which are known to prevail solely at great altitudes. M. Hildebrandsson has organized a small body of observers, and in the above work represents their observations on a series of charts. As far as we are able to judge, he appears to have evidence in favour of the views of the circulation of the upper currents, which he has enunciated, but we shall be glad to see further proof. We do not understand why the charts are not for consecutive days, and we think that in his next paper the author should chart each consecutive day for say one month.

It is also most desirable that he should obtain a wider spread staff of observers. One each in Spain, Italy, the Crimea, Northern Russia, Ireland, and at the top of the Gulf of Bothnia, are indispensable. If no Irish observer will volunteer, surely one Englishman, or a Scotchman, will come forward. By using Goddard's cloud mirror, the observation is both easy and interesting, while extreme punctuality is not important. Perhaps General Myers will add it to the elements observed by his staff—if so, the question could be determined in a few months.

ON VARIATIONS IN THE FREQUENCY OF THUNDERSTORMS.

A STATISTICAL investigation on the subject of thunderstorms, was not long since made by M. von Bezold, of the Munich Academy, on the basis of data furnished by fire insurance companies, as to the production of fires by lightning in the Kingdom of Bavaria. It appeared from this enquiry, beyond a doubt, that there were both differences as to space, and time periods, in the occurrence of the phenomena; M. von Bezold, therefore, was determined to prosecute the subject further, and work out the data of observation of the larger meteorological observatories, taking as long a period as possible. Unfortunately the available material was very defective, for very often no attention was paid to thunderstorms among the meteorological phenomena at the stations; on the other hand, sometimes only the days of the storm were noted, sometimes only the individual storms, sometimes only the thunder, sometimes each flash of lightning was recorded. Nevertheless, M. von Bezold found himself in a position to form tables of the comparative numbers and the means, for the year 1764 to 1867, which showed a series of regular varieties of the thunderstorms. While, as the author points out, the material is not quite trustworthy for the whole of the period men-

tioned, and gains in authority as we come nearer the present—the stations being numerous, and observations more exact—still the occurrence of minima at particular epochs is undeniable ; from these the frequency gradually increases, and then decreases to the next minimum.

The variations in frequency are made still more evident by the curve which M. von Bezold constructs from his numerical data, in which the years are taken as abscissæ, and the means of all observations as ordinates. In order to form an estimate as to the dependance of thunder-storms on other meteorological elements, the author compares this curve with the temperature curve for the same time, and with the curve of sun-spots, whose relation to many meteorological phenomena has of late excited so much interest. The temperature curve shows the divergences of the mean yearly temperature from the entire average for our latitudes, while the sun-spot curve is so constructed that the lowest parts correspond to the maxima of sun-spots. Now, on comparison of these three curves, it appears that the curve of thunderstorms takes a mean position between the temperature curve, which in general it follows, and the sun-spot curve, with which also it generally harmonises ; so that by combining the sun-spot curve and the temperature curve, a curve very like that of the thunder-storms is obtained. Hence the following conclusion, according to M. von Bezold, is rendered highly probable :—

"High tenperatures, as also a spotless condition of the sun's surface, produce years with abundant thunderstorms. Now, as the mutations of the sun-spots coincide with the greatest intensity of auroras, it follows that both groups of electric phenomena, thunderstorms and auroras, to some extent compensate each other ; so that years with abundant thunder-storms correspond to years with few auroras, and conversely.

"Such a connection between sun-spots and thunder-storms in no way requires us to suppose an immediate electric reciprocal action between the earth and the sun, but may be simply a result of the extent of insolation as conditioned by the covering of spots. These changes of insolation become perceptible in different latitudes (according to Koppen), not simultaneously, but successively. The phenomena of thunder-storms, on the other hand, depend not only on the conditions of temperature of the particular place, but also on the state of the atmosphere at far distant points belonging to another zone. In this way the peculiar middle position, which is taken by the curve of thunder-storms, between the spot and the temperature curve, may possibly one day be explained."—*English Mechanic.*

BOOKS RECEIVED.

AUSTRIA.

JELINEK, C., und F. OSNAGHI. "Jahrbucher der K. K. Central-Anstalt für Meteorol ɔgie und Erdmagnetismus, Jahrgang, 1873." 4to. Vienna, 1875.

BARBADOS.

RAWSON, The Hon. R. W. "Rainfall in Barbados, for the year 1874." Fcap. folio.

,, ,, ,, "Rainfall in Barbados, Feb. and March, 1875." Fcap. folio.

DENMARK.

"Bulletin Météorologique du Nord, publie par les Instituts Météorologiques de Norvége, de Danemark et de Suède." April, 1875. Oblong 4to.

NEW ZEALAND.

HECTOR, J., M.D., F.R.S. "Meteorological Report for 1873." 8vo. 1874.

,, ,, ,, "Statistics of New Zealand for 1872. Part VI. Meteorology." Fcap. folio.

,, ,, ,, "Abstract of Meteorological Observations, August —December, 1874." Fcap. folio.

MAY, 1875.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1860–5	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Date.	Min. Deg.	Date.	No. of Nights below 32° In shade	On grass
			inches	inches.	in.								
I.	ENGLAND.	Camden Town	1·61	— ·79	·41	28	13	78·3	14	39·8	31	0	0
II.		Maidstone (Linton Park)	1·38	— ·86	·41	28	8	82·0	15	40·0	31	0	0
,,		Selborne (The Wakes)	1·95	— ·53	·48	6	11	75·5	15	34·2	3	0	1
III.		Hitchen	2·00	+ ·07	·53	28	12	71·0	15	36·0	16	0	...
,,		Banbury	2·11	— ·11	·56	7	14	77·0	15	39·0	17‡	0	...
IV.		Bury St. Edmunds (Culford)	2·15	— ·01	·78	28	10	77·0	15	33·0	30	0	4
V.		Bridport	2·41	+ ·38	·52	6	13	73·0	14	34·0	11	0	..
,,		Barnstaple	2·61	+ ·17	·55	6	14	79·0	15	41·5	11	0	...
,,		Bodmin	3·09	+ ·63	·41	21	16	72·0	15	43·0	13	0	0
VI.		Cirencester	2·39	+ ·11	·34	6	11	...	...	...	...	...	...
,,		Shifnal (Haughton Hall)	1·15	— 1·11	·25	28	11	69·0	14	36·0	30	0	0
,,		Tenbury (Orleton)	2·56	— ·32	·69	28	13	78·3	14	36·2	23	0	0
VII.		Leicester (Belmont Villas)	1·80	...	·35	20	14	77·5	14	38·0	30	0	...
,,		Boston	1·05	— ·89	·26	20	12	81·0	14	37·0	30	0	...
,,		Grimsby (Killingholme)	1·55	...	·29	28	14	70·0	12*	39·0	17‡	0	...
,,		Derby	...	...	...	...	...	...	...	...	...	...	...
VIII.		Manchester	...	..	...	...	...	...	...	...	...	...	...
IX.		York	1·61	— ·34	·26	8	14	75·0	14	38·0	30	0	...
,,		Skipton (Arncliffe)	4·45	+ 1·10	·69	20	19	75·0	14	32·0	16	1	...
X.		North Shields	·72	— 1·92	·19	8	14	70·0	14	39·0	3	0	..
,,		Borrowdale (Seathwaite)	7·80	— 1·74	1·13	17	17	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely)	...	..	...	..	...	...	...	...	...	...	...
,,		Haverfordwest	2·86	+ ·14	·59	19	12	73·0	14	41·0	30	0	...
,,		Rhayader (Cefnfaes)	...	...	...	...	...	...	...	...	...	...	...
,,		Llandudno	1·46	— ·92	·43	27	13	72·9	14	38·5	1	0	...
XII.		Dumfries (Crichton Asylum)	1·73	— ·66	·30	6	18	68·8	6	35·8	19	0	0
,,		Hawick (Silverbut Hall)	1·36	...	·40	23	12	...	...	...	...	...	...
XIV.		Kilmarnock (Annanhill)	...	...	...	...	...	...	...	..	..	...	...
XV.		Castle Toward	3·05	— ·34	·62	22	18	66·0	5	...	...	...	...
XVI.		Leven (Nookton)	1·19	— ·81	·24	8	13	70·0	4	36·0	19	0	7
,,		Stirling (Deanston)	...	...	...	...	...	..	...	...	..	...	...
,,		Grandtully	1·58	...	·42	21	15	...	...	..	...	...	...
XVII.	SCOTLAND.	Braemar	1·64	— ·16	·53	21	14	64·7	30	35·3	17	0	3
,,		Aberdeen	1·66	...	·60	27	16	73·8	14	38·8	24	0	1
XVIII		Loch Broom	4·17	...	·61	6	19	...	...	...	...	...	..
,,		Portree	6·83	+ 1·18	1·04	11	24	...	...	...	...	...	...
,,		Inverness (Culloden)	·86	— ·70	·20	25	11	65·4	7	38·2	6	0	0
XIX.		Helmsdale	1·94	...	·50	19	13	...	...	...	...	...	...
,,		Sandwick	1·51	— ·75	·46	28	17	...	...	...	...	...	...
XX.		Caherciveen Darrynane Abbey	3·31	...	·85	20	15	...	...	...	...	...	...
,,		Cork	2·42	...	·50	6	9	...	...	...	...	...	...
,,		Waterford	2·61	+ ·36	·70	6	15	69·0	27†	41·0	30	0	...
,,		Killaloe	3·13	— ·05	·60	20	21	77·5	14	38·0	22	0	...
XXI.	IRELAND.	Portarlington	1·74	— 1·46	·41	22	20	76·0	14	38·0	15	0	...
,,		Monkstown, Dublin	1·20	— ·71	·32	21	14	...	...	...	...	...	...
XXII.		Galway	3·68	...	1·25	20	21	70·0	14	38·0	19	0	...
,,		Ballyshannon	1·78	...	·51	11	14	...	...	...	...	...	...
XXIII		Waringstown	1·79	...	·30	10	19	75·5	15	34·0	16	0	4
,,		Edenfel (Omagh)	2·79	...	·83	21	20	66·0	14	35·0	18	0	0

* And 14, 15. † 25. ‡ 30.

+Shows that the fall was above the average; —that it was below it.

METEOROLOGICAL NOTES ON MAY.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; TS for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

LINTON.—A very dry, fine month, the middle portion especially being very warm for the season. T on the 19th and 28th; brisk, but not high, winds on 18th, 20th, 22nd, and 30th; H on 19th. Vegetation, which was very late at the beginning of the month, made great progress, so that at the end it was as forward as in the average of seasons, and most of the crops promise well.

SELBORNE.—A remarkably fine and dry month. Crops, both cereal and hay, and also hops, very promising. Frost on the grass on the 3rd; TS at 8 p.m. on 18th; H at 9 a.m. and TS at 1 p.m. on 19th; violent storm at Alton at 10 a.m. on 22nd; TS at noon on 28th; fall of R here ·33; at Petersfield the water in the streets was 2 feet deep. Prevailing winds—first half of month, S and S.W.; towards the close, N.E.

BANBURY.—TS and H at 4.20 p.m. on 18th; H at 1 p.m. on 19th; high wind 6th on 22nd.

CULFORD.—The grass about here was crisp with frost on the morning of the 31st. The mean temp. of the month 54°, which is in excess of that of the corresponding month of 1874. Easterly winds on 10 days, and westerly on 21 days. T with H occurred on the 19th and 28th.

BRIDPORT.—The refreshing showers this month have caused vegetation to advance rapidly, making up for lost time; an abundant hay harvest is anticipated. Heavy H with T on 19th.

HAUGHTON HALL, SHIFNAL.—This May has been remarkably free from frost, the ther. not having fallen to the freezing point, not even on the grass, on any night, though it fell within 1° of it on the 30th. Owing to the prevalence of N. and E. winds and the deficiency of R, the pastures were by no means forward at the close. The trees came early into leaf: the oak and ash by the 14th, and in the fullest leaf by the 29th; the hawthorn in great blossom by the 18th, and the hollies so beyond precedent; a prospect of a good supply of fruit of all sorts, apricots especially. Willow wrens first heard on 3rd; turtle dove on 6th; fly catcher first seen on 13th; mushrooms gathered in field on 10th.—*Erratum.* Total rainfall in March, ·82 —1.12.

ORLETON.—The first 11 days were generally cloudy but pleasant, with an even temp.; the air then became nearly cloudless, and remained very hot with brilliant sunshine till the 17th, when a distant TS occurred in the night, followed by light showers for several days; the remainder of the month was generally fine and pleasant, with a copious fall of R on 28th. The mean temp. of the month was nearly 2° above the average, and the progress of vegetation has been very rapid. The apple trees were generally in full blossom about the middle of the month. T was heard on 17th, 21st and 28th, and L seen on 17th and 28th.

LEICESTER.—The R which fell in the 1st and 3rd week, with the warm days between them, had a marvellous effect on vegetation. TS between 11 and 12 p.m. on 17th; T at 9 a.m. on 19th; fine rainbow at 7.20 p.m. on 22nd; scarcely any E. wind till last few days.

BOSTON.—The mean temp. 1°·7 below the average of the previous 11 years; the ther. very variable, ranging from 81° to 37°; R less than average; TS with heavy R on 20th. Lilac and laburnum in flower from the 11th to 13th, and the thorn about the 17th.

KILLINGHOLME, GRIMSBY.—A fine, warm month; late sown barley cannot grow for want of R; but the springs are higher than they were at the corresponding time last year. Great promise of a good fruit crop. House martins arrived on 2nd, white-throat on 5th, spotted fly-catcher on 9th, and swift on 19th. Horse-chesnut and lilac flowered on 8th, the hawthorn began to flower on 13th (it is unusually beautiful). Potato tops injured by frost on 17th; TS at 6.15 p.m. on 18th, Killingholme Lighthouse struck.

ARNCLIFFE.—Beautiful spring month; vegetation very forward.

SEATHWAITE.—T on 5th; H on 22nd; S on the hill tops on 16th; only five days on which more than half-an-inch of R fell, and only two on which 1 in. was registered.

WALES.

HAVERFORDWEST.—A very fine month; total absence of frost; grass and corn crops luxuriant; general appearance of the country better than for years past. Temp. cool throughout the month, with the exception of a remarkably hot period, 13th to 15th. From the 26th to the end the air was very cold, owing to the prevalence of a strong polar current. Whitethorn coming into blossom on the 27th; ash in leaf on 12th; oak on the 19th. Wind, W. and S.W. on 12 days, the remaining days from N.W., N., or E.N.E.

LLANDUDNO.—A dry month, notwithstanding which the crops generally are making satisfactory progress. Horse-chesnut in flower on 4th; hawthorn and laburnum on 7th; mountain ash on 10th, and wild rose, elder, and seringea on 27th. Landrail heard on 6th.

SCOTLAND.

DUMFRIES.—Mean temp. 51°·7, being 4° higher than last year; a good month for vegetation, the temp. never having fallen to the freezing point, although one half of the month was dry and cold from the prevalence of E. wind; the first half of the month was most genial and mild. Heavy H storm at 3.30 p.m. on 18th.

HAWICK.—T on the afternoon of the 23rd; H on 18th; very stormy on 21st. The month has been entirely free from frosts, and the garden fruits have set well. Apples, pears, cherries, apricots, gooseberries and currants betoken a good crop. Though the country is looking well, R is much wanted.

CASTLE TOWARD.—A most satisfactory month; the R which has fallen on 18 days has told favourably on all the crops; cereals making rapid progress; pastures looking well generally, but, hillward, the crop is late; the hay suffered from dry spring; rye grass is shooting into flower, and is short; turnip sowing is being pushed forward; potatoes look very well; fruit is nothing to what was expected from the blossom. On the 16th a fine hive of bees cast, considered very early.

BRAEMAR.—A month of fine weather, but somewhat dry. TS at 7 p.m. on 21st, and at 5.30 p.m. on the 22nd.

ABERDEEN.—Mean temp. 51°·7, or 3°·4 higher than the average for May during 18 years; R below the average; winds from W. and S.W. greatly in excess of the average. A remarkably fine, dry month, and without any frost. T at 5.30 p.m. on 8th, and in early morning of 9th; TS and heavy H at 5 p.m. on 18th.

LOCHBROOM.—Except that it was rather too wet for preparing the ground for turnips, the weather was all the farmer could desire, and the sheep farmers have found the lambing season quite to their satisfaction.

PORTREE.—A cold, wet month. Heavy H showers on 20th, 21st, 22nd and 23rd, with strong squalls.

IRELAND.

DARRYNANE ABBEY.—The wettest May for the last six years in quantity, though only about the average in the number of days. Wind variable, light to moderate. Crops progressing, and grass growing fast; a good month for the farmers.

WATERFORD.—Wind high on 21st, 22nd, and 23rd.

BALLYSHANNON.—This month has been a very fair one, though the temp. has been lower than that of April. Crops in this neighbourhood are looking well, and there has not been any damage to potatoes, either from frost or blight.

WARINGSTOWN.—Crops looking remarkably well, considering the dry weather.

OMAGH.—Weather of this month very favourable to vegetation, but owing to the prolonged drought of April, too late to thoroughly recover the hay crop. The rare fact of there having been no frost during the month causes the prospect of fruit to be unusually good.

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THE FLOODS IN THE SOUTH OF FRANCE.

GREAT disasters wherever they occur always command British sympathy and, if need be, usually obtain important pecuniary aid. While any help which we could obtain would hardly be more than a drop compared with the stream of disaster which has swept down the valleys of the northern slope of the Pyrenees, we cannot write upon the subject without in the first place assuring our readers that the loss is most serious. Englishmen have no idea of what a flood means; perhaps the statement by Prof. Raulin that, at Langon, the flood was 38 ft. in height, will give the best idea of what a disaster the late one has been. Suppose we had a 38 ft. flood in the Thames it would cover the whole of—

South bank... Battersea Park, Lambeth, Southwark, Bermondsey, Deptford.

North bank.. Fulham, Chelsea, Brompton, Belgravia, Westminster, St. James's Park,

while as for the new Embankment, a steamer might ply over the top of it. Happily for us, we have no Pyrenees at the head of the Thames and need fear no such disaster, but we can sympathize with our neighbours, and many of our readers can, and we trust will, help them.

On hearing of the disaster we wrote our distinguished *collaborateur*, Professor Raulin, for particulars. He has kindly sent us a most interesting reply, of which the following is a translation :—

MY DEAR SIR,—Immediately after the receipt of your letter I read over all the accounts in the journals, and transmit herewith all the general indications which I have collected. The daily and monthly amounts of rainfall have not yet been received.

The inundation, even more disastrous than that of 1855, which has ravaged the valleys of the south-west of France between June 22nd and 28th has been occasioned by torrential rains, and by snow falling during the three or four preceding days, especially on the northern slopes of the Pyrenees at the head of the Adour, the Garonne, the Aude, and some other small tributaries of the Mediterranean.

The rains also prevailed over the adjacent high lands of the plains of Gascony, in the centre of which are the heads of various affluents of the Garonne, and again to the N. of the eastern half of the Pyrenees

on the Black Mountain at the head of the Tarn, one of the principal affluents (on the right hand) of the Garonne.

But these rains did not extend to the central plateau of France, nor further than to the northern part of the plains of Gascony, for on the one hand the Lot, which descends from the first and crosses the second, has not been in the least flood, any more than the Drot, which is in the N.W. Again, at Bordeaux the rainfall was quite ordinary, that of the 20th and 21st (even including the small subsequent fall up to the 29th) being *under one inch.*

On the southern slope of the Pyrenees not a drop of rain fell, and the sky was cloudless except in the north, where the Spanish observers saw a persistent belt of clouds.

All the French valleys which furrow the country above indicated have been inundated, but it is in the valley of the Garonne rather than in that of any one of its affluents that the greatest disasters have occurred, because at its junction with the Tarn near Moissac it collects the waters of a great number of tributary streams—those of nearly half the length of the Pyrenees, and of the eastern part of its basin. Over most of the course the floods acquired a height and volume greater than those in 1855, and as that is 20 years since, the principal flood was a very long time descending from the head of the valley to the sea at Bordeaux. According to the Engineers of the *Ponts et Chaussées*, the following are the data of the Inundation wave in the Garonne :—

Station.	Time of highest flood.	Greatest elevation.
Cazères ...	June 23rd, 7 a.m.	... 18 ft.
Toulouse ...	,, ,, 10 p.m.	... 24 ,,
Agen ...	,, 25th, 9 p.m.	... 37 ,,
La Réole ...	,, 26th, 4 a.m.	... 34 ,,
Langon ...	,, ,, 9 p.m.	... 38 ,,
Bordeaux ...	,, ,, (?27th) 2 a.m.	... affected by tide.

The floods of the upper Garonne and of the Tarn, which separately rose to 24 ft. and to 23 ft. at Toulouse and at Montauban, attained after their junction below Moissac, at Agen, and at Langon, a height of 36 ft. to 39 ft., which would have been even greater below Agen if the rains had unhappily extended to the watershed of the Lot.

The inundation wave took *three days and a half* to descend from Cazères, at the foot of the mountains, to the lower parts where, as at Langon, the tide begins to be felt : that is to say, 86 hours for about 155 miles, or a mean progress of less than *two miles per hour.*

A system of telegraphic warnings previously well organized in each principal valley would have been of great utility, could have given useful warnings, and would have materially lessened our losses. How many precautions might have been taken in the country between Cazères and Langon, and even Bordeaux, distant more than 155 miles, during the 86 hours between the occurrence of the maximum flood at Cazères on the 23rd at 7 a.m., and its arrival at Langon on the 26th at 9 p.m.—Yours very truly,

V. RAULIN.

Bordeaux, July 2nd, 1875.

It was our intention to have given a map of the district, and to have entered fully upon the consideration of the subject, but it seems better to postpone it until Prof. Raulin has received the rain returns from his stations, many of which are admirably placed for the purposes of this enquiry.

We cannot, however, leave the subject even temporarily without supporting most heartily Prof. Raulin's remarks on the necessity of organizing a system of warnings like those now in operation for Lyons and for Paris.

WHIRLWIND AT BALDOCK, HERTFORDSHIRE.

On the morning of June 15th the following paragraph appeared in *The Times*:—

Mr. E. Smith writes to us from Baldock, Hertfordshire :—"Some of your readers may be interested to know that this place was visited during the afternoon of Saturday by a wind of extraordinary strength and fury for so inland a situation. About 1 o'clock a brief thunderstorm, culminating in one loud cracking peal, passed over the town from the south-west, and shortly afterwards, and in its wake, a very low and gloomy cloud was seen to be approaching with remarkable velocity. The cloud appeared to be of a hollow or perhaps spiral shape, horizontally inclined, with a huge whirling tail; indeed was so monstrous and furious in its aspect as to be positively terrible. Immediately the air near it was observed to be filled with branches and leaves of trees, slates, stones, dust, &c. The phenomenon came on with awful energy across Mr. Thomas Pryor's park and the upper part of High-street, close to the ground, and in about a minute more was passed and gone, leaving behind it a sulphurous smell. Then it was discovered that not only had the wind dismembered and uprooted several large trees in its course, but had thrown down the greater portion of an extensive block of modern and valuable maltings belonging to Mr. Pryor, and situated in a somewhat sheltered corner in the rear of his park, causing a loss which I am sorry to say £1000 will barely cover. The whirlwind seems to have been only a few yards in diameter, and its course, which was somewhat circular, from S.W. to N.E. [1] As lightning itself so often does, the storm showed in its effects a remarkable caprice; but happily no injuries to life or limb occurred, although one or two persons had a narrow escape."

Knowing the locality and some of the gentlemen mentioned, we were satisfied of the authenticity of the statement, and therefore started at once for Baldock, and spent a day in thoroughly examining the effects of the whirlwind. As we desire to devote our space chiefly to the consideration of the manner in which these effects were produced, we avail ourselves, as far as possible, of descriptions of them by other persons. We, therefore, next reprint the account given in the *Hertfordshire Express*, appending to it, as we have done to Mr. Smith's, foot notes, critical and explanatory. On the whole, both accounts are very good.

EXTRAORDINARY STORM OF WIND AT BALDOCK.

A hurricane, the like of which is not remembered by the oldest inhabitant, passed over the town of Baldock on Saturday last, causing, in its impetuous and resistless course, a very considerable amount of damage. The cyclone approached

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[1] The evidence of this circular motion seems very slight.

Baldock from the south-west, and its passage is marked in a meadow of Mr. Lowe's by the branches torn off the trees and strewn in all directions over the meadow. Next, the maltings, belonging to Mr. Thomas Pryor, of the Park, Baldock, in the occupation of Mr. Page, standing on ground adjoining the farm homestead of Mr. Lowe, fell a prey to its fury. These maltings are of modern construction, having been built about fourteen years ago on the site of maltings which were then destroyed by fire. The buildings of which these maltings form part consist of a long malt warehouse and drying kilns, running from east to west, probably about 200 feet in extent. From this building three maltings branch out at right angles from south to north, thus presenting their broad side to the whole force of the storm, and sustaining, as the sequel will show, nearly the whole of the damage. The malting which was first injured is a building 150 feet long, by 44 feet broad. The damage to this structure appears to have been caused by the pressure of the wind on the outside of the roof, for all the windows were shut and the appearance the roof presented just after the occurrence seems to point to this conclusion.[2] The centre of the roof for, perhaps, 100 feet was crushed inwards, and the walls above the ground floor were pushed over and lay on the floor above. Half the roof rested on the upper floor, while the other half with the wall on the east side were precipitated and lying, at the time of our visit, in a heap of ruins in the intervening space between this and the next building. The barley loft next Mr. Lowe's farm has resisted the storm and is still standing, but the wind, by its pressure on the roof, has swayed the end wall so much that it is doubtful whether the upper portion will not have to be rebuilt.[3] The lower floor has sustained no injury. The centre malting was of considerable dimensions, about 100 feet long by 50 broad. The damage done to this is nearly entirely confined to the roof. It appears that one of the maltsters was working in this building in the morning, and consequently the side shutters were all open. The wind, entering by these apertures, separated the east half of the roof from the other half longitudinally and quite lifted it with the boards and rafters from the main principals and framework. These latter, except one, remain in position and, with the western half of the roof, are almost intact. It is stated that it took 30 tons of slates to cover the rafters, so that the wind must have had sufficient force to lift fifteen tons besides the rafters and boarding, and to turn them completely over into the yard below. The roof of the drying kiln, which joins the end of this malting, is tiled, and a portion of it appears to have been lifted up simultaneously with that of the malting, and the two coming in contact fell on to the upper stage of the malting with so much force as to break one of the principals —a beam 11 inches deep by 6 inches thick—and the *debris*, probably several tons in weight, remained, at the time of our visit, a confused heap of tiles, slates, rafters, beams, and boards. The covering to the kiln technically termed a mushroom, or kimberlo, with the iron work which supported it, was lifted out of its place by the wind and deposited on this heap. The general appearance of the interior of this malting bears out the theory that the force of the storm was expended internally and that the roof facing towards Hitchin was strong enough to resist the outside pressure.[4] The malting by the side of the road leading to Willian has suffered much in the same way as the one first described. The storm has crushed in the roof from the outside, carrying inwards the west wall and forcing out a portion of the upper wall by the roadside and half the roof to the ground beneath. Some of the principals and framing of this roof were forced

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[2] This can hardly be admitted, as the pitch of the roof on the side whence the wind came is almost perfect, merely lifted bodily eastward, and allowed to fall because several of the principals broke when dropped upon the wall on the east side. The west wall appears to have been drawn over by the pull of the roof.

[3] This is a very important fact, for this building was full of barley to within a few eet of the ridge, hence this building hardly contained any air and it sustained scarcely ny damage.

[4] It is very satisfactory to find that the writer of this description has here enunciated the very theory we had been led to adopt.

through and embedded in the outer wall.[5] It was the custom for a brass band to practise here, and the forms where the musicians sat and the lamps they had last used were there, after the storm had spent its fury on the building, uninjured. The road was almost impassable for a time from the accumulation of rafters, boards, bricks, and tiles; the trees in the park on the other side, besides being damaged and torn about by the raging of the wind, had their branches filled with slates and broken rafters; and in the meadow beyond a large piece of roof had fallen, giving evidence of the great violence and power of the storm. The buildings, viewed from the top of one of the dismantled maltings, presented a most remarkable sight. The roofs of the outside maltings had been torn asunder for, perhaps, 80 feet of their length, and at each end the jagged ends of boards and protruding beams and rafters gave the idea that a terrible railway accident might have happened there. The ruin was almost as complete as if a fire had again occurred, but without the consolation that follows from a fire insurance. It was fortunate that the malt lofts, which stood end ways to the storm, resisted its force, for a considerable quantity of malt was in store, and the loss would have been much more serious had the buildings containing it been damaged like the maltings. As it was, scarcely any malt was lost or damaged. It is fortunate also that the catastrophe happened at a time of year when no malting was being carried on. If the storm had occurred in the autumn or winter probably Mr. Page would have sustained great inconvenience and loss.

The trees in the park on the other side of the road were torn and large arms were twisted off them, but at this point the whirlwind appears to have risen, and no more damage was done until it reached the other side of Baldock, where a tree was torn up by the roots and other trees were much damaged.

Mr. T. B. Latchmore, of Hitchin, has photographed the damaged maltings, and no doubt the vivid representation of the catastrophe will ensure a large sale. —*Hertfordshire Express*, June 19th.

We must also here insert a letter with which we have been favoured by Mr. Lucas, and a few scraps of miscellaneous information :—

SIR,—I hope your expedition on Tuesday last to the scene of devastation at Baldock was not unproductive. Since I saw you I have learned a few details of the course of the storm. At Little Offley (where I have established a rain gauge), 3 miles S.W., in addition to the wind which damaged trees very much, there was a most extraordinary hailstorm, many hailstones being considerably over an inch across, and being star-shaped. Out of curiosity Mr. Lawson's bailiff weighed some of them, and 123 hailstones weighed $\frac{3}{4}$-lb; this was at Lilly, one mile S.W. of Little Offley. The hurricane crossed the Bedford-road half-a-mile N. of Hitchin, damaging a house, then did great damage in what we call "Fishpond Closes," went on to Grove Mill, damaging the poplar trees there, and then over an open country —I presume, to Baldock—on to Royston, where it appears to have done considerable damage.—Yours faithfully, W. LUCAS.

Hitchin, 21st June, 1875.

HITCHIN.—TERRIFIC STORM.—About twenty minutes to two on Saturday afternoon a westerly hurricane of unusual violence swept over a portion of this town and district. The beautiful trees in that portion of the place known as the Fishponds were much damaged. Huge boughs were torn off, tossed up in the air to a considerable height, and carried a great distance. No damage was done to

[5] The appearances are correctly described, but we believe that the roof was raised bodily a foot or two and lifted eastwards, thereby drawing over the west wall and explaining the sawn appearance which the bricks had where unbroken principals had cut their way down through even three courses of bricks.

house property, beyond the carrying away of a few tiles and chimney pots.—*Leighton Observer.*

HITCHIN.—On Saturday afternoon, about twenty minutes to two, a westerly hurricane of terrific fury, passed over a portion of this town. Near the Union a few tiles were taken off the roofs of cottages, and some slight damage was done to Mr. Richardson's back premises in the Bedford-road. The trees in the Fishponds suffered much, the tops of many being wrenched off, and tossed high in the air and then carried some distance. Passing in the direction of Grove Mill, the trees easily succumbed to the wind, and the tall poplars at the latter place were much damaged.

Between Letchworth and Baldock a man had been at work on a straw stack, but at the time of the hurricane he was fortunately away, for when he returned he found the stack scattered all over the field. Another man was violently thrown against a gate, to which he had to cling until the hurricane passed.

At Baldock there was a very serious destruction of property, and it seems miraculous that there was no loss of life. Mr. R. Page's malting, situate near Mr. Lowe's farm, was almost entirely unroofed. The building covers more than an acre of ground and was substantially built, being only about 15 years old. It consisted of three buildings 155 ft. long and 45 ft. wide, running parallel, and joined at one end. In the end storehouses was 500 quarters of malt, but the other houses were undergoing a thorough cleansing. On Saturday afternoon no one was at work upon the premises, or there must have been loss of life. An eye witness says, about twenty minutes to two, whilst near the maltings, he heard a noise as of thunder, accompanied by the snapping of trees, and on looking round he saw the trees falling a prey to the furious wind. Quickly it came on and caught the maltings broadside. All the windows were open, and the wind entering there, the roof was lifted into the yard between the next block of buildings. The heavy rafters were torn out, brickwork gave way, and the slates were carried a long distance. The two other buildings shared the same fate, the roof of the outside one being deposited in a slanting position into the adjoining road. The air was filled with *débris*, and the trees in the beautiful avenue opposite, next fell before the rapacious wind, completely blocking up the roadway. The property belongs to Mr. Thomas Pryor, and is in the occupation of Mr. R. Page. It is estimated that the damage done will exceed a thousand pounds. As a proof of the fury of the hurricane, we may mention that slates from the roof were carried some distance, and then deeply driven into the trunks of the trees. Some of the wood was carried a distance of 500 yards.

From Royston a correspondent writes to say that about 15 cwt. of lead on the roof of the church was rolled up "like a pipe light." A very high chimney stack at the Priory, the residence of Joseph Phillips, Esq., was blown on to the roof, breaking through from gable to eaves, but fortunately no one was hurt. A very fine chestnut tree, belonging to the Rev. Medway, had a large arm blown off, which was carried a distance of thirty or forty yards.—*Herts. and S. Beds. Journal.*

We had intended to give a map of the path of the whirlwind, but the country traversed presented so few objects which could be affected, that the injury, except at Baldock, is very slight, while the length of the track is quite 19 miles. The following are the details of the traces above recorded. Assumed line of centre of whirlwind extends from 4 miles W.S.W. of Hitchin to Royston. Its direction was from W. 28° S. to E. 28° N., or, roughly, from W.S.W. to E.N.E.

The first trace is at Lilley (lat. 51° 56′ N., lon. 0° 23′ W.), distance from assumed path (which commences here) 0·7 mile N. At Little Offley (1½ miles from commencement of track) damage was done 0·6 miles N. of path. Hitchin Fishponds are 4·3 miles along the path, and absolutely on it. Grove Mill is 4·9 miles along and 0·1 mile N. of path. The scattered hayrick, in Letchworth parish, was 7 miles

along and 0·1 mile N. of path. The maltings at Baldock are 8·7 miles along and absolutely on the path, but the two trees on the other side of Baldock, and 9·3 miles along, are 0·2 mile (350 yards) S. of the path. Lastly, Royston forms the extremity of the path. The close agreement of all these cases with a rigorously straight line is remarkable.

In the next place we must say a few words respecting the illustrations, premising that nothing but Latchmore's large photographs would give anyone an idea of the wreck at Baldock. The length of these remarks is much reduced by the accuracy of the description quoted above from the *Hertfordshire Express*, which we need only supplement. Each building consisted of two floors, the upper of which had no ceiling but the roof. The end of each range is cut off from the long malting floor by a vertical wall, and none of these end buildings was unroofed. The most westerly range, which was first struck, is represented in the engraving.

The whole of this roof (A) was either lifted and dropped, or else pushed about 4 ft. eastwards, the walls from the level of the upper floor to the eaves of the roof were thrown over eastwards, the west one falling on to the floor just mentioned, and the east wall of course falling outwards into the yard. From the fact that the bricks of the west wall were not in the least disarranged (they lay quite ready for rebuilding), and that the slates on that side were almost free from injury, we cannot believe that the roof was pushed bodily eastwards by a westerly wind. It is well known that the passage of a whirlwind over a pond will empty it (*e.g.* see *Met. Mag.*, vol. viii., p. 168); now this means that it will raise many tons of water, for 36 cubic feet of water weigh a ton, therefore a pond 20 ft. in diameter, and 2 feet deep, would contain nearly 20 tons of water. Again, from what we know of the rate of diminution of pressure in the greater whirlwinds which we call cyclones, it is surely not unreasonable to assume that in the very limited area and high intensity of a true whirlwind there is a diminution of pressure of half an inch of mercury. If so, as half an inch of mercury represents a quarter of a pound on each square inch of surface, or 36lbs. on each square foot, we should have the diminution over the damaged part of this building, say 120 ft. by 40 ft, or 4,800 feet = (4800 × 36 =) 172800 lbs. or 77 tons, whereas the slates and timber probably only weighed about half that amount.

Without wishing in any way to dogmatize upon the subject, we must express our belief that the passage of the whirlwind produced such a diminution of pressure as caused the air in the building to expand, and to lift the roof, and that the motion of translation of the whirlwind caused it to be dropped about 4 ft. further eastwards than its original position.

The damage to the second range of buildings (B), though quite different to that done to the first, is capable of similar explanation—in fact, it is remarked by the reporter that "*the force of the storm was expended internally.*" Both walls, the principals, and nearly every slate on the

side from which the storm came, were undisturbed; but of the eastern slope of the roof not a vestige remained—rafters, boards, and slates had all gone, as cleanly and neatly as if they had been purposely removed.

The third range (C) suffered very much in the same manner as the first, but there was one feature in which difference existed—the east wall was not thrown into the lane, as it should have been to render the similarity perfect, and several of the principals had sawn their way (no other term so well expresses the appearance) through two and even three courses of bricks. We do not know why this difference occurred, there are obviously two explanations, but perhaps neither is correct. It may have been that the wall, being the outer one of the premises, was built with better materials than the others, but the whole of the buildings were very substantial—otherwise, for instance, the upper floor of the first building could not have supported the roof in the position shown in the engraving. Another explanation is that perhaps the whirlwind was rising rapidly when it reached the last range of buildings, and therefore exerted lifting rather than tractional power.

Lastly, there remains the transverse building (D), and its almost perfect immunity to be considered. Here, again, two explanations offer themselves. It may have been that the whirlwind did not pass over it, or it may have been—and we incline to the opinion—that inasmuch as the building was full of malt far above the eaves, and nearly to the ridge, there was not enough air inside to produce sufficient expansive force to lift the roof.

Looking at the slates sticking in the trees like so many axe heads, it would be ridiculous to deny that there was a very strong wind; but the impression left upon our mind is that the prime cause of the disaster was the expansion of the air inside the large malting floors, consequent upon the sudden passage over them of a whirlwind, in the centre of which the atmospheric pressure was greatly diminished.

We must not conclude without expressing our thanks to Mr. Page, the occupier, for the courteous assistance which he has given us, both when inspecting the ruins and subsequently.

WHIRLWIND IN SHROPSHIRE, JULY 6TH.

To the Editor of the Meteorological Magazine.

SIR,—I beg to send you an account of a whirlwind which was witnessed here yesterday by several of my friends, from whom I have the account, and upon whom I can rely for its truth.

About 4.30 p.m. on the 6th inst. (wind, light breeze from E.) a whirlwind was seen crossing from E. to W. a field of 10 or 12 acres, on which was lying loosely a crop of hay nearly made, and collecting a great quantity in its passage. A portion of the hay so collected was carried over the hedge, and deposited in the adjoining field; but the greater quantity—estimated at from 2 to 3 cwt.—was whirled to a

height of 200 feet into the air, and carried in a bulk at a great speed over an adjoining hill, half-a-mile distant, where it was lost sight of, part of the hay being caught by some trees on the summit, but without apparently breaking the form, which was undefinable.

Weather at the time very hot, with sun shining.

Although these winds are not rare, yet circumstances combine to render this one noticeable, as not only are they seldom observed in this locality, but, some years ago, during the building of a church a few yards distant from the same field, a wind of a similar character occurred, and a serious accident was the result, viz., the demolition of the partly finished roof of the church, and injury to the workmen engaged on it.—I am, Sir, yours &c.,

E. GRIFFITHS.

Bishop's Castle, Salop, 7th July, 1875.

REDUCTION OF BAROMETER READINGS TO SEA LEVEL.

To the Editor of the Meteorological Magazine.

SIR,—May I offer a few remarks on a subject alluded to by a correspondent in the May number of your magazine—viz., the reduction of barometrical observations to the sea level.

I suppose the correction mentioned as deduced from Sir Geo. Shuckburgh's formula is intended to apply to the *mean* height of the barometer. It is plain that the correction itself must vary as the height of the barometer at the place of observation varies.

It seems to me that a simple method of obtaining the correction required at any place, and for any reading of the barometer, may be derived from the tables, or the formula, for determining the heights by the barometer.

1.—Thus to take (*e.g.*) the tables supplied by the Astronomer Royal to Messrs. Negretti and Zambra for the graduation of their aneroids. Let M be the number of feet in the table answering to the reading of the barometer at the place of observation (corrected for temperature); N the number of feet corresponding to the (required) reading at the sea level; c the corrective factor for the mean temperature of the air; h the known height above the sea level of the place of observation; then

$$h=(\mathrm{M}-\mathrm{N})\ (1+c)\quad \text{or, } \mathrm{N}=\mathrm{M}-\frac{h}{1+c}$$

Now since

$$\frac{1}{1+c}=1-c+c^2-c^3+\&c.$$

and c is small, being in fact

$$=\frac{2\ \text{mean temp.}\ -100}{1000}$$

We may take $\mathrm{N}=\mathrm{M}-h\ (1-c)$ nearly, when h is not very large.

Then N being determined from this formula, we can find in the table

the barometric pressure corresponding to it, *i.e.*, the pressure at the sea level.

The only difficulty is in the determination of the mean temperature, *i.e.*, what increase of temperature is to be assumed for the sea level. I do not know whether the rule given by Herschell ("Meteorology," p. 22) is still generally followed, viz., to allow 1° of temperature for 300 ft. of height. But taking the best known rule, if t be the temperature observed, T the difference to be allowed for the height (which is constant) then

$$c = \frac{2t + T - 100}{1000}$$

This method will, I think, give the barometric reading correctly as far as *hundredths* of an inch.

2.— If greater accuracy is desired, one might use the formula (from Baily's "Astronomical Tables") given in the Admiralty "Manual of Scientific Enquiry," p. 156. The formula is

$$\log h = A + C + \log D$$

where

$$D = \log B - \log B'.$$

B, B', being the readings of the barometer at the lower and upper stations, A and C being corrections (for which tables are given) depending upon temperature and latitude. From that formula we have

$$\log D = \log h - (A + C)$$

and

$$\log B = D + \log B'$$

whence (with the help of a table of logarithms), B, or the required barometric pressure at the sea level, may readily be found.

It would not be difficult for an observer to construct from this formula a table *for his own place of observation*, which would give the reading of the barometer at the sea level corrresponding to any observed reading and any temperature.—Yours faithfully,

J. G. H.

EXCESSIVE RAINFALL.

To the Editor of the Meteorological Magazine.

SIR,—The rainfall of June and the early part of July in the present year, has been somewhat interesting, especially in connexion with the disastrous floods in France. It is well known that generally in June the European or Continental summer rains set in, and these appear to have commenced in the south-east of England on or about the 10th of June, and to have continued here until the 21st. During these twelve days 2·10 inches of rain was registered, 0·75 inch having fallen during the 24 hours preceding 9 a.m. of the 18th. Five dry days followed, when a second group of eight days set in on June 27th, and continued to July 4th, the quantity registered being 2·18 inches,

0·81 inch having fallen during the 24 hours preceding 9 a.m. of the 4th July. The aggregate quantity during the two groups amounted to 4·28 inches.

The fall of rain at this station during the recent June has exceeded that of any previous June, 1871 to 1875, by 0·15 inch, 2·83 inches being the quantity registered in June, 1871.

The excessive rainfall of the 25 days, June 10th to July 4th, 1875, is best appreciated by a comparison of the rainfall as registered here during the same 25 days in the years 1871 to 1875. The numbers are as follows:—1871, 3·185 inches; 1872, 0·975 inches; 1873, 2·320 inches; 1874, 1·335 inches; 1875, 4·280 inches. Excess of 1875 above 1871, 1·095 inches.

It may probably interest some of your readers to make similar comparisons from their own journals.

I am, Sir, your obedient servant,

W. R. BIRT.

Cynthia Villa, Walthamstow, July 8, 1875.

SUPPLEMENTARY TABLE OF RAINFALL IN JUNE, 1875.

[For the Counties, Divisions, Latitudes, and Longitudes of these Stations, see Met. Mag., Vol. X., p. 28.]

Station.	Total Rain.	Station.	Total Rain.
	in.		in.
Acol	1·49	Gainford	1·98
Hailsham	2·89	Shap	4·24
Strathfield Turgiss	3·04	Llanfrechfa	5·54
Addington Manor	3·36	Castle Malgwyn	2·45
Oxford	2·97	Heyope	3·66
Cambridge	3·46	Melrose	3·25
Sheering	3·18	Cessnock, Glasgow	2·74
Ipswich	2·80	Gruinart	2·18
Diss	2·16	Keith	2·20
Swaffham	2·08	Strathconan	2·13
Compton Bassett	3·22	Springfield, Tain	2·11
Hessary Tor, Dartmoor	8·25	Skibbereen	3·14
Teignmouth	3·70	Fermoy	3·96
Torrington	5·10	Kilrush	5·06
Trevarrick, St. Austell	3·67	Kilkenny	2·78
Taunton	3·02	Kilsallaghan	2·82
Cheadle	3·13	Twyford, Athlone	3·07
Ashby de la Zouch	3·47	Ballinasloe	3·80
Coston, Melton Mowbray	2·88	Kylemore	7·45
Bucknall	2·51	Bangor	4·64
Mansfield	2·63	Carrick on Shannon	5·04
Walton, Liverpool	2·96	Warrenpoint	4·74
Broughton-in-Furness	4·83	Bushmills	2·98
Stanley, Wakefield	3·52		

UPPER-CURRENTS OVER AREAS OF DEPRESSION.

To the Editor of the Meteorological Magazine.

SIR,—I make no apology for asking you to insert the accompanying extract from a letter to M. H. Hildebrandsson on some points touched upon in his "Essai sur les courants supérieurs de l'atmosphère." because, whether my own theory be correct or otherwise, the attention devoted by meteorologists in our country to the upper-current circulation is still sadly unequal to the importance of the subject.

Yours truly,

W. CLEMENT LEY.

"I have now a collection of several thousand cirrus observations, chiefly made in the British Isles, arranged according to their relation to the distribution of atmospheric pressure at the earth's surface, and am engaged in their discussion. I may say that the results of my investigations hitherto are in close accordance with the principal results described in your Essay.

"Only on one point I must still differ from you. The more observations I accumulate the more firmly I am convinced that, at least as regards the British Isles, the axis of a cyclonic circulation commonly inclines backwards. When I wrote the 'Laws of the Winds prevailing in Western Europe,' my observations were comparatively few in number. Since that time I have made and obtained a large number, and possess many simultaneous observations taken in different places. The year 1872 alone, when depression-centres were unusually numerous in Great Britain and Ireland, furnished upwards of 70 observations of cirrus made over the centre of the bourrasque existing at the earth's surface. In very nearly all cases an upper current lay over the depression-centre, which upper current was *nearly* in accordance with the current *previously* experienced at the earth's surface, *e.g.*, in a depression travelling to N. it was from some south-easterly point; in a depression travelling to E., from a S. or S.W. point. Thus the westerly wind in the former case, and the northerly in the latter, appeared to occur in the lower regions of the atmosphere before they reached the higher.

"Similarly, in several instances in which an anticyclone has followed in the immediate wake of a cyclone, I have noticed a N. or N.W. upper current to exist over the central calm of the anticyclone.

"I am quite aware of the complexity of the investigation arising from the fact that the upper currents flowing off one area of depression cannot always be distinguished from those which form part of another. But it is in the largest, the best defined, and the most isolated depressions that the phenomenon I have described is most clearly observed.

"It was this phenomenon that was one of the first things which led me to adopt the conclusion (which I still believe to be correct) that the eastward motion of our depressions is not so much due to the prevailing force of the westerly currents acting as a *vis a tergo*, as to the fact that the depression perpetually *reproduces itself* to the eastward of its former position, such reproduction being due to changes of

tension taking place primarily in the lower strata. To this theory your remark, that friction will retard the motion of the inferior part of the depression, does not apply; to any other it would.

"Although, however, I believe that the central calm of a depression on the earth's surface is in advance of the corresponding calm in the higher regions, it appears to me that the whole disturbance or circulation of air is frequently of greater extent in the higher than in the inferior region. Consequently, when a depression is approaching, even though its axis inclines backwards, the banks or belts of cirrus, travelling from S.W., W., or N.W., may frequently be observed overhead, a little *before* the S. or S.E. wind has commenced on the earth's surface.—I remain, yours respectfully.—W. CLEMENT LEY."

REVIEW.

Annales de l'Observatoire Physique centrale de Russie publiées, par H. WILD. Année 1869; 4to.; St. Petersburg, 1874.

Annalen des Physikalischen Centralobservatoriums herausgegeben, von H. WILD. Jahrgang, 1873; 4to.; St. Petersburgh, 1875.

DR. WILD is not only keeping up current work, but he is also working up arrears. We have previously noticed his annual volumes for 1870-1 and 2 at considerable length. We have now before us those for 1869 and 1873, that for 1868 has failed to reach us, but it has evidently been published, because Dr. Wild says in the preface—

"The Annals of the Observatory for the year 1869, which I now present to the public, are reduced on precisely the same principles, and with the same precautions as those of the previous year."

The relative bulk of the volumes now before us indicate very approximately the development of the Russian Metorological system.

The 1869 volume is useful chiefly as prolonging the series backwards, and because its supplement contains a valuable series of daily observations at Naronowo (near Novgorod), from 1854 to 1862.

It differs from all the later volumes in that the letterpress is in Russian and French, whereas the later volumes are in Russian and German.

The volume for 1873 is a great work, great in bulk, for it consists of 793 quarto pages, and great in the area of country it represents, for it includes stations differing by 40° in latitude and by 120° in longitude, say, roughly, one-thirtieth of the entire surface of the globe. The volume is also great as regards the quantity of work put into it, for it is arranged on the Vienna pattern, and is perhaps the most compressed mass of meteorological data yet published. At the same time it is scarcely anything but a storehouse of well-arranged facts, and if we had not in pleasant remembrance the excellent papers which Dr. Wild and his staff contribute to the *Repertorium*, and for which papers volumes such as this are useful, if not necessary, we should be sorely tempted to enquire whether the persons who actually *use* the data thus published are sufficiently numerous to justify the great cost (in England it would probably be £600 or £700) of printing it.

JUNE, 1875.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1860–5	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Date.	Min. Deg.	Date.	No. of Nights below 32°. In shade	On grass
			inches	inches.	in.								
I.	ENGLAND.	Camden Town	2·41	+ ·64	·56	30	15	85·1	9	43·3	1	0	0
II.		Maidstone (Linton Park)	2·30	— ·44	·65	11	10	83·0	3, 8	47·0	20*	0	0
,,		Selborne (The Wakes)	3·60	+ ·37	·84	21	15	75·4	4	39·5	1	0	0
III.		Hitchen	2·75	+ ·11	·42	29	18	75·0	3	41·0	21	0	...
,,		Banbury	2·97	— ·31	·46	17	13	79·0	3	40·0	1	0	...
IV.		Bury St. Edmunds (Culford)	2·83	+ ·25	·41	10	15	81·0	4	39·0	21	0	0
V.		Bridport	2·39	— ·85	·55	30	12	77·0	2	39·0	19	0	..
,,		Barnstaple	4·01	— ·11	·66	15	19	80·0	3, 4	47·0	5	0	...
,,		Bodmin	3·54	— ·50	·44	13	21	73·0	3	47·0	22	0	0
VI.		Cirencester	3·42	+ ·04	·43	27	14	...	...	...	...	...	...
,,		Shifnal (Haughton Hall)	2·63	— ·48	·58	29	14	75·0	3	41·0	1	0	0
,,		Tenbury (Orleton)	2·32	— 1·20	·47	10	15	79·5	3	39·2	22	0	0
VII.		Leicester (Belmont Villas)	4·35	...	1·67	29	15	84·2	3	41·0	1	0	...
,,		Boston	...	...	...	...	...	...	...	...	...	...	...
,,		Grimsby (Killingholme)	3·07	...	1·40	29	14	74·5	25	43·0	1	0	...
,,		Derby	...	...	...	...	...	...	...	...	...	...	..
VIII.		Manchester	3·56	+ ·22	..	..	19	...	...	...	...	...	...
IX.		York	2·10	+ ·20	·56	28	15	...	...	...	...	...	...
,,		Skipton (Arncliffe)	4·65	+ ·55	·53	15	19	75·0	24	38·0	26	0	...
X.		North Shields	1·57	— 1·17	·49	29	14	73·6	25	42·0	2	0	..
,,		Borrowdale (Seathwaite)	10·90	+ ·39	1·42	14	21	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely)	...	...	...	..	...	...	...	...	...	...	...
,,		Haverfordwest	3·39	— ·26	·58	8	17	76·0	2	43·0	26	0	...
,,		Rhayader (Cefnfaes)	...	...	...	...	...	...	...	...	...	..	...
,,		Llandudno	1·81	— ·48	·33	14	16	74·9	3	45·4	1, 2	0	...
XII.	SCOTLAND.	Dumfries (Crichton Asylum)	3·89	+ 1·06	1·00	15	21	75·8	4	39·8	1	0	0
,,		Hawick (Silverbut Hall)	2·76	...	·36	30	17	...	...	...	...	...	...
XIV.		Kilmarnock (Annanhill)	...	...	...	...	...	...	...	...	...	...	...
XV.		Castle Toward	2·94	— ·55	·51	16	19	73·5	3	...	...	...	...
XVI.		Leven (Nookton)	2·41	+ ·17	·50	14	18	71·0	24	38·0	1, 3	0	5
,,		Stirling (Deanston)	...	...	...	...	...	..	...	...	..	...	...
,,		Grandtully	2·86	...	·29	13	18	...	...	..	...	...	...
XVII.		Braemar	2·00	— 1·44	·37	16	14	75·7	2	33·3	14	0	7
,,		Aberdeen	3·36	...	·89	26	19	74·0	24	38·0	14	0	0
XVIII		Loch Broom	3·05	...	·35	5	23	...	...	...	...	...	..
,,		Portree	4·81	+ ·03	·92	14	23	...	...	...	...	..	...
,,		Inverness (Culloden)	1·58	— ·34	·46	14	17	67·9	1	39·9	12	0	2
XIX.		Helmsdale	1·83	...	·51	14	16	...	...	...	...	...	...
,,		Sandwick	1·45	— ·09	·42	14	14	65·2	4	43·7	13†	0	0
XX.	IRELAND.	Caherciveen Darrynane Abbey	5·37	...	·83	8	19	...	...	...	...	...	...
,,		Cork	3·01	...	·54	9	14	...	...	...	...	...	...
,,		Waterford	3·27	+ ·28	·45	27	22	75·0	3	42·0	11	0	...
,,		Killaloe	4·97	+ 1·34	·77	9	23	78·0	2	41·0	20	.	...
XXI.		Portarlington	2·29	— ·96	·40	15	23	73·0	24	41·5	20	0	...
,,		Monkstown, Dublin	2·29	— ·32	·30	11	...	...	...	...	...	...	...
XXII.		Galway	3·91	...	·46	13	25	78·0	2	44·0	29	0	...
,,		Ballyshannon	3·43	...	·50	27	19	...	...	...	...	...	...
XXIII		Waringstown	3·51	...	·63	14	20	77·0	3	40·0	4‡	0	0
,,		Edenfel (Omagh)	2·64	...	·43	27	17	71·0	3	36·0	20	0	0

* And 22. † 14. ‡ 18, 21.

+Shows that the fall was above the average; —that it was below it.

METEOROLOGICAL NOTES ON JUNE.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

LINTON.—The first ten days very dry, and often hot; the unusual occurrence of brisk winds, with T, took place on the 11th, and very high winds, for June, followed for some days after, with some showers. Dry weather commenced again on the 17th, and continued with only one intermission until the 28th, on which and two following days nearly 1 in. of R fell. Bar. generally steady; wind mostly S. and S.W. The R at the end of the month very beneficial.

SELBORNE.—Distant T from 11 a.m. to 3 p.m. on 9th; T S in the morning of 21st, and heavy R till the evening; T S, with H, on 18th; T on 11th, 12th, 28th, 29th, and 30th; fog on 4th and 25th; heavy dew on evening of 16th; a water-spout observed at Alton on 17th. Much hay spoilt through premature cutting. Prevailing winds S.W. almost all the month.

HITCHIN.—The stormiest June I ever remember, and most T and H, with high gales; on the 29th, the ground looked as though under S, owing to heavy H.

BANBURY.—T SS on 3rd, 4th, 9th, and 17th; that on the 17th was very violent, but very limited in extent, hardly reaching beyond the river Cherwell, into Northamptonshire, and not extending two miles on the S. and W.; much R and H fell, and a barn and cottage were struck by L, and set on fire; T on 29th.

CULFORD.—Easterly winds prevailed during the first and last week, and westerly during the middle of the month. Mean temp. 59°·3. T on 9th, 11th, 16th, 17th, 18th, and 28th.

BRIDPORT.—A fine warm month, with refreshing showers. The greater portion of the hay harvest secured, and the crop exceptionally heavy.

SHIFNAL.—The drought of May lasted till the 9th of June, with N.E. winds, and a bright sun for four days, when it changed to S.W., followed by copious R to 16th, lowering the temp. about 7° to 63°—65°, at which it continued, with two exceptions (24th and 25th), till the close. On the 27th the R which had ceased, returned still more copiously, and continued daily till the 30th; nearly a continuous fall from 4 p.m. on 27th to 11 a.m. on 30th. Total 1·32 in. T in the distance on 20th. Grain crops coming early into ear with short straw. Swedes and mangel-wurzel saved by the R.

ORLETON.—A pleasant month, and very favorable for all the growing crops, with a rainfall of nearly the average quantity, occurring chiefly between the 8th and 18th, and 26th and 30th. Mean temp. very near the average of the month. T heard 3rd, 9th, 10th, 11th, 17th, and 29th, and L seen on 3rd, 9th, and 17th, but no heavy storms. The wind frequently strong; violent on 15th. Wheat coming into ear about the 14th, and into blossom about the 26th.

LEICESTER.—Very fine and warm during the first week, then showery till 19th. Very heavy R, with T S in afternoon, on 29th; the heaviest falls were between 1.50 and 2.10 p.m., and between 3.20 and 3.40 p.m.; total fall in 24 hours, 1·67 in.. Total fall in the half year ending June 30th, 12·08 in.; the average at Wigston being 11·61 in.; the excess is 0·47 in. T S at 11.30 a.m. on 9th; at 9.20 a.m. on 11th; and at 10.30 p.m. on 17th.

GRIMSBY.—Distant T on 4th and 17th; T at 4 p.m. on 9th, at mid-day on 11th, at mid-day, with high wind in evening, on 15th, in the afternoon of 21st and morning of 29th. Heavy R in some parts of the county on the 17th, but not any here. A splendid fall of 1·40 in. of R here on 29th. Dog rose in flower on 6th.

ARNCLIFFE.—T S on 13th and 14th.

NORTH SHIELDS.—T on 12th, and two T SS on 15th.

SEATHWAITE.—T on 15th, 16th, and 29th; H on 9th and 16th.

WALES.

HAVERFORDWEST.—The first three days and the last day were warm and genial; temp. over 70°; all the rest of the month was chilly, cloudy, and wet; temp. during the day seldom rising above 60°. Grass and hay abundant, but weather very trying for securing the hay. Prevailing wind westerly.

LLANDUDNO.—Privet in flower on 18th; wheat and barley on 16th. Hay harvest begun on 21st. With the exception of a few cold days between 10th and 16th, June was a fine genial month, its mean temp. rather more than 1° above the average, and its rainfall below it.

SCOTLAND.

DUMFRIES.—Winds chiefly W. and S.W.; rather cold from 4th to 11th. Temp. variable, and nearly 2° below that of last June; the latter half of the month was the warmest. R frequent, but with one exception (1·00 on 15th), not heavy; no T S.

HAWICK.—Slight T SS on the mornings of 4th and 14th. The month has been a genial and warm one, and there is a splendid crop of hay.

CASTLE TOWARD.—Turnip sowing completed in this district, and the cutting of hay begun; all crops look well.

BRAEMAR.—T and H at 5 p.m. on 12th, and T at 2 p.m. on 16th. A month of excellent weather throughout.

ABERDEEN.—A month of quiet, mild, but showery weather. Fog on 2nd, 6th, and 30th. T S in early morning on 6th, and another on 12th; H on 16th and 26th. Bar., temp., and pressure of wind all below the average; rainfall above it.

LOCHBROOM.—Splendid weather, sunshine and showers alternating; grass, potatoes, and all crops looking luxuriant and promising; and on the whole it has been the finest June we have had for years.

PORTREE.—A fine growing month, although a little wet for turnip sowing. The crops look well everywhere.

SANDWICK.—June has been drier and warmer than the mean; the weather generally has been very pleasant; and vegetation has made great progress. The max. temp. in the shade ranged from 60° to 65° during 10 days, and in the sun from 110° to 115° during 6 days.

IRELAND.

DARRYNANE ABBEY.—Wettest June for 6 years. A foggy, cold month, delaying harvest operations much; and I am sorry to say that the blight is showing itself in the potatoe crop, though not to any extent.

BALLYSHANNON.—The temp. in the first part of the month was considerably below summer heat; the latter part has been more favorable to growth, heat and moisture coming together.

WARINGSTOWN.—The dripping weather during the first fortnight improved all crops, which now look flourishing; dry weather wanted for haymaking, which is backward.

EDENFEL, OMAGH.—Weather generally rainy and unsettled, and cool for the time of year, but the growth of the other crops has in no way been retarded, and there is every promise of an abundant harvest.

HEAVY FALL OF RAIN ON JUNE 29TH.

WE have received the following observations of the amounts of rain registered on June 29th, the greater part of which fell during thunderstorms in the afternoon and evening:—

Newport Pagnell, Bucks	2·76
Cardington, Beds.....	2·50
Leicester, Belmont Villas	1·67
Dunmow, Essex	1·46
Grimsby	1·40
Wakefield, Stanley Vicarage.....	1·33
Horncastle, Bucknall	1·08

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THE BRITISH FLOODS OF JULY, 1875.

ACCORDING to all precedent we ought to write for this number an entirely original article descriptive of the effects of the late floods; but we do not always obey precedents, and we think that it is waste of time, and bad policy, when facts have been once well arranged and expressed to re-dress them in other language simply in order to obtain an appearance of originality. The present article will therefore consist of—

1. General description of the floods (reprinted from the *Daily News* of July 23rd).
2. Short statements of actual damage.
3. Rainfall statistics.
4. Remarks on the whole matter.

"The disastrous weather which has made the present July one of the wettest on record seems still to linger over the whole country between the Scottish border and the Channel. It is clear to the north of us, and fine to the south of us, but the whole of England and the south of Ireland seem to lie under a belt of storms. The news from various parts of England which we publish to-day (23rd) is of the same tenor as that of former days. A wet morning and evening in London, with fine weather between, was typical of what the day was all over the land. In the Eastern Counties the sky was brighter, and in the Midland district the rain had ceased; but there were tremendous thunderstorms and deluges of rain at Bath and in North Wales. Last week the downfall was universal, though the main force of the almost tropical floods was felt in the west; this week the weather has been a little more chequered, though floods of almost equal violence have come down on the Midland Counties. On Sunday (18th), when we were rejoicing in a day's sunshine in London, a great thunderstorm was raging in Lincolnshire, and over the whole district from Sheffield to Birmingham, and the first five days of the week have each been distinguished by its separate deluge in various parts of the country. On Monday (19th) there were severe thunderstorms at Newcastle, extending as far north as the central districts of Scotland. That day and Tuesday (20th) were wet over the greater part of the Midland and Northern Counties. On Tuesday the Eastern Counties were deluged, and the rain fell in torrents all over Leicestershire and Warwickshire. At Birmingham the downpour, which began at noon on that day, lasted twenty hours, and was succeeded on Wednesday evening (21st) by another violent thunderstorm. At the same time the valley of the Kennet from Hungerford to Reading was subject to a similar visitation, and the heavy rain extended to Windsor, while another rainstorm deluged the country from Bedford to Leicester. Yesterday (22nd), as we have already said, the deluge came down at Bath and in the district round that city. In this way nearly the whole of the island seems to be visited in turn, not only with the

storms to which we are accustomed in July, and which make it one of the wettest months in the year, but with a long series of hours of heavy rain, with thunder and lightning here and there, but usually, as in London, with rains of autumnal persistency rather than the suddenness of summer showers. Meanwhile it may be noted that some parts of the country have to a large extent escaped. The Liverpool papers speak of the comparative immunity of their district from the overwhelming torrents which have fallen elsewhere. The north of Ireland has been almost untouched by the storms; and during the present week the weather is reported as on the whole finer in the extreme west of England, and along the southern coast. The atmostpheric disturbances which produce the heavy precipitation shift about; but wherever the rain falls it has the same characteristics of unusual persistency and unparalleled quantity.

"It is no wonder that our natural drainage systems should fail to carry off this remarkable rainfall. It is difficult to form any idea of what is really meant by an inch or two inches of rain coming down over an immense drainage area. Such a quantity deposited on the slopes of the Pyrenees, either in melting snow or rain, rolls down their sides and gathers in a river channel like that of the Garonne, and rolling along towards the sea must carry everything before it. We have had the same thing on a smaller scale in Wales and Monmouthshire last week, and have it all over central England at the present moment. Wherever there is high ground on the watershed the river below has been seriously swollen. The hills of Charnwood Forest have sent down floods which have deluged Leicester, and the hills of Derbyshire and Staffordshire have sent down water enough to inundate the whole valley of the Trent. The Thames rises more slowly than other English rivers, but many of its affluents, such as the Loddon and the Kennet, are flowing over the meadows which border them, and even the Thames itself is in many places over its banks. Smaller streams, such as the Leam at Leamington, the Rea at Birmingham, the Tame which gives its name to Tamworth, the Avon at Rugby, and the Dearne in South Yorkshire, have been swollen into torrents. Indeed the harvest landscapes would have presented a strange aspect to any who could have got a bird's-eye view of them yesterday (22nd). Along all the level lands the meadows were swamped, and almost every river valley would present the appearance of a lake. In the fens of Cambridgeshire and Northamptonshire the water is said to cover the country for miles; the valley of the Nene, near Peterborough, is flooded; the Welland and the Witham have deluged the villages along their course, and from inland Leicester the Soar is reported to have made the country "like a sea." The sluggish Ouse naturally covered the level lands with its waters, and though hundreds of acres of well-cropped fields are inundated, it was reported as still rising last night (22nd) at Bedford Bridge; even as high up in its course as Buckingham it is reported as flooded. Everywhere in fact, from Evesham in the west to Wisbeach and Lynn in the east, and from the Kennet valley to the Ribble at Preston, the summer landscape is the prey to winter floods.

"It is impossible to make any estimate of the damage which this visitation of water has caused. Even the injury to houses, factories, roads, railways, and bridges is immense, for news of damage of this kind comes from all quarters, and seems everywhere, probably from the suddenness of the floods, to be of a more serious character than usual. The most melancholy aspect of the whole is, however, the relation of the weather to the crops. We have had hitherto a singularly favourable year. May brought no nipping frosts, but was cold enough to keep back vegetation, and the season was late, itself a proverbial pledge of fruitfulness. The dripping June also verified the jingling proverb which credits it with bringing all things into tune. Even the grass crop promised well, the wheat was good, the barley unusually heavy, the oats were plentiful, the root crops prosperous, and it was a good year for nearly every kind of fruit. The deluge in July has disappointed nearly all the hopes based on this happy condition of the fields. Some hay was got in early in the month, but when St. Swithin brought his forty-eight hours of incessant rain, a good part of the crop was still lying in swathes on the meadows or standing uncut. Over thousands of acres, the cut grass is now floating on the surface of the water which has covered the meadows, and

large quantities have been borne away. The damage to the hay harvest is beyond all possibility of recovery, and will probably transform a year which promised to be one of plenty into one of scarcity. Of the other crops it is as yet premature to speak. Our Norwich Correspondent, in reporting that last night the sky had been clearer in the Eastern Counties, says that the aspect of the country is better than could have been anticipated. The wheat is knocked about to some extent, but has generally borne the heavy rains pretty well; the barley, which in many parts of the country was the best and most promising of all the crops, has suffered more, and everywhere the cereals are kept back by the want of warmth and sun. The cornfields should by this time be turning yellow in the sunshine; but they are still of a dark green, and where the colour has begun to change they show the effects of the wet. Still the harvest is probably not very seriously damaged, and the general tenor of the reports from the agricultural counties is that, except in the river valleys, little damage has been done which the speedy return of sunshine might not repair. As to the hope of any such return we do not venture to prophesy. We may, however, point out as perhaps a hopeful feature that during the bad weather of this week and last the sky has usually been reported as clear on the coast of Norway and in the north of Scotland; while the weather also seems to have changed for the better all over those parts of France which were first visited by the floods. Local damage excepted, a dry August would probably leave the agricultural interest in general but little the worse for the bad weather of July, as the splendid root crops would probably compensate for much of the injury done to the cereals; and even an autumnal hay crop might be possible. It is at any rate premature at present to speculate on a winter of dear bread, when there is time even yet for the long-delayed summer to come and make the autumn fruitful."

Examination of the following pages will show that we have compressed the statements of damage as much as possible, and it has been no slight task to do so; it would have been much easier to have filled 50 or 60 pages than it has been to condense the record into one-tenth of that space. However, it is done, and though it would be expecting too much did we anticipate that no errors will be found in it, we believe that they will be very few. It will be seen that the record is divided into two portions, in order to separate the primary Monmouthshire rains, from the subsequent ones.

NOTES ON THE FLOOD OF JULY 15TH.

III. *Banbury.*—The Cherwell in flood; hay suffered severely.

III. *Northampton.*—The Nene over its banks; great quantities of hay spoilt.

IV. *Ipswich.*—Wheat and barley in many fields lying level with the earth, and quite soddened; low grounds flooded.

V. *Dorchester.*—Low-lying lands flooded, but not much permanent injury.

V. *Plympton.*—The little Larey overflowed and flooded some adjacent marsh land, but did no serious damage.

V. *Bath.*—The Avon rose rapidly on 15th to 10 ft. above its usual summer level, overflowing its banks in many places, and carrying away hay. Several low-lying houses inundated, and two thoroughfares for a time impassable. Much meadow land under water, and the grain crops badly laid. A girl fell into the river, and it was running so fast that no one could save her.

V. *Yeovil.*—Deep floods in Mid-Somerset; moorlands under water, and much hay washed away.

V. *Frome.*—The river overflowed; the principal entrances to the town were up to noon (16th?) impassable for pedestrians, and the water reached the floors of the market carts; several shops were closed, the water being 2 ft. deep.

VI. *Bristol.*—The low-lying poor district of Baptist Mills was several feet under water, the ground floors were uninhabitable, and people went in boats to deliver bread to the people in the upper rooms.

VI. *Cinderford.*—Hay crop nearly all destroyed in this neighbourhood, and a few animals and fowls washed away. The great cause of destruction was, however, the sudden discharge of the contents of a reservoir nearly 20 acres in extent through the bursting of a dam across the Blakeney brook, which, though happily causing no loss of human life (except one indirectly), destroyed nearly all that was in its course, and flooded the little town of Blakeney, Walmer's colliery, and the Silly Point Iron mine. The Whimsey railway was much damaged. For several miles along the valley of the Severn the land was submerged, not even the tops of the hedges being visible.

VI. *Hereford.*—The Wye rose to 11 ft. by the morning of the 15th, and to 14 ft. by the evening, thereby approaching the height of the great flood of 1852. Many sheep and lambs, a horse and a donkey were brought down, and also timber, hurdles, hay, &c. The Lugg overflowed its banks near Mordiford, and it was found necessary to launch boats upon the highway between Mordiford and Hampton Bishop. The Dore overflowed at Dorstone, and some of the cottages had 1 ft. of water in the ground floors. Near Letton much land was under water, and the road from Willersley to Letton was impassable for many hours.

VI. *Leominster.*—The Arrow much flooded; a bridge over the railway from Leominster to Kington was undermined and partially gave way, so that trains could not pass it.

VI. *Worcester.*—The river rose very rapidly, the meadows on each side of it from hence to Gloucester were under water; much hay was carried away and grass spoiled. There was a heavy spate down the Teme, which overflowed its banks, as did also the Avon between Evesham and Tewkesbury.

VI. *Stafford.*—From four miles north of Stafford to Tring many thousand acres of ground were under water, and the greater part of the hay was spoiled.

VII. *Leicester.*—Floods have been general in the low-lying parts of this county, especially near Aylestone, Blaby, and Narborough. In some fields waggons might be seen immersed to their axles in water, and surrounded by floating hay.

VII. *Nottingham.*—The Trent rose higher than it has done in summer for many years, and overflowed its banks in some places, but no serious damage was reported.

XI. *Newport.*—Several bridges washed away at Pontheor and other

places. The railway traffic on the Eastern and Western Railways of the Monmouthshire Company, and on the local lines of the Great Western Railway has been interrupted, and in some cases suspended, while miles of turnpike road and thousands of acres of land are deeply covered with water. In the western valleys scores of cottages are rendered uninhabitable and the inmates have left, leaving everything behind them, and thankful to escape with life. At Pontymisti, Risca, and villages higher up, the same desolation prevails. The greatest amount of damage in this valley is in the neighbourhood of Abercarne, where the vale is narrow, and the waters are penned in. Here springs have burst forth from the mountain side, carrying in their progress masses of débris, and obstructing road, river, and rail, which all run nearly parallel through the narrow defiles. Opposite Risca Station two immense patches have been scoured away from the mountain side. At Cross Keys two separate torrents came down upon the line, and taxed all the energies of a gang of men to prevent the rails and sleepers being carried away. Here the railway crosses a low wooden bridge, the main support of which was swept off, and stranded a quarter of a mile lower down. Above Abercarne a portion of the line was deranged, and an engine with trucks laden with balks went up the line to replace the damage. In passing under Mynyddislwyn Mountain a landslip fell upon the train, and carried the trucks into the wood below, completely covering them up. At the end of the trucks were the brake vans, filled with labourers. These were dragged a few yards down the line, and turned over. Fortunately the labourers escaped unhurt, but had they been in the centre of the train, probably not a man would have escaped with life. The coupling chain snapped, and the engine did not leave the line. In the Eastern valleys a slip took place at the Vartey, which stopped the trains between Blaenavon and Pontypool. Numerous small bridges have been swept away, but as yet no loss of life is reported. The new line of the Great Western between Caerleon and Pontnewydd is much damaged in places.

XI. *Chepstow.*—Unprecedented floods; garden produce washed out of the soil, lower parts of houses flooded, and furniture swimming about.

XI. *Pontypool.*—Tremendous floods; the gas works under water, and the furnace fires extinguished. Pontnewydd turnpike under water.

XI. *Monmouth.*—There was considerable agricultural loss in this county, all the low-lying valleys being under water; but it was dwarfed by the bursting of a reservoir, known as Roger's Pond, in the Ebbw valley near Cwm Carn, the waters of which subsequently breached the Monmouthshire Canal, thereby adding to their own volume the contents of that section of the canal. Considering the large volume of water thus liberated, we think that the mortality has been singularly small, being limited to the occupants of two houses, which, standing in the valley below the reservoir bank, were swept away by the first rush of the water.

XI. *Usk* very much flooded, at Caerleon a railway bridge was

reported to be much damaged, and traffic was suspended between Newport and Pontnewydd.

XI. *Cardiff.*—The rivers Taff and Ely overflowed their banks in many places; the damage to hay was immense; one farmer estimates his loss at £500. Flocks of sheep have been washed down both rivers, and also horses and a large number of pigs. At St. Fagans the railway was more than 2 ft. under water, near Canton Common, at Grangetown, and in the village of Ely many houses had the water 4 or 5 ft. deep, so that the inhabitants could only be visited or removed in boats. The turnpike road between Cardiff and St. Nicholas was impassable for one whole day.

XI. *Tongwynglais.*—The Taff rose to a great height; the Pentyrch works were flooded, and at Nangarw there was 6 ft. of water over the turnpike road.

Bridgend.—The Ogmore overflowed its banks, a boy was washed away, and much cattle and farm produce was destroyed.

XI. *Pontardulais.*—Floods much out in this neighbourhood; railway traffic stopped between Pontardulais and Pantyffynon, and also between the latter station and Brynaman.

NOTES ON THE SUBSEQUENT FLOODS.

II. *Windsor*, 20th.—Heavy rain and many brooks overflowing.

Newbury.—Very heavy thunderstorm between 6 and 7 p.m. on 21st, meadows on the side of the Kennet under water.

III. *Oxford*, 20th.—The floods are now over the towing path in many places, and Port Meadow is nearly covered.

Banbury, 22nd.—Great floods; scarcely anything but water between here and Oxford. Traffic stopped on East and West Junction Railway.

Brackley.—The lower part of Syresham is so flooded that communication between one part of the village and another is stopped.

Northampton.—Fields adjoining rivers, canals, and brooks, were entirely submerged, while in many instances the water ran over the roads; hay and grain crops considerably damaged; much injury done to a tan yard by the pits being filled with rain water, and the liquor spoilt, an engine was set to work to pump out the water, but its furnace was gradually put out and rendered useless. Most mills, breweries, foundries, &c., had to stop work on account of the flood, the engine fires being in many cases extinguished.

Northampton.—Such a flood as visited us is only just within the ken of the oldest inhabitant, and indeed only on record thrice in 250 years, viz.:—On the 2nd July, 1622, when the flood was so high that people in the S. and W. parts of the town had to be carried about in boats; on the 6th of May, 1663, when the water came as high as St. John's Hospital, forcing away two of the arches of the South Bridge; and at Christmas, 1821, when the water washed away the foundations, &c., of several houses and buildings at the lower end of the town. Many of the inhabitants, remembering the floods in 1849 and 1872, had prepared for the recent one by stopping up likely places for its

entrance, or removing their property either to buildings standing higher, or to the upper parts of their houses.

Higham Ferrers.—On Wednesday Higham was converted into an island, being completely surrounded with water, but no striking damage has been done except to the hay crops.

Ravensthorpe.—Very heavy rain on Sunday, from 5 to 6.15 p.m. 1·14 in.; in previous 24 hours, measured 9 a.m. of the 21st, 1·965.

West Haddon.—Streets and houses flooded on Sunday, and were not in a much better state by Wednesday.

Yelvertoft.—On the Rugby and Stamford railway a cottage was washed away, and also about 150 yards of the railway embankment.

Brigstock, July 18th.—Terrific thunderstorm, the rain flooding the houses as it fell, not by swelling the streams but by itself; yet at Lyvedon, about 3 miles from Brigstock, there was not sufficient rain to lay the dust. They had rain again on Monday and Tuesday, and on Wednesday the water was rising.

Thrapston.—Several heavy coal barges have been washed from the river, and are now drifting about in the fields.

Burton Latimer.—A man endeavouring to save some sheep was carried away and drowned.

Raunds.—A culvert made last year at £170 expense burst in several places, and helped to deluge the town. Mr. Nichol's employed several wagons to fetch in his sheep, or they would all have been drowned.

Stamford and Peterborough.—Traffic has been stopped between these places.

Northamptonshire.—The Fens totally submerged for miles; many acres of grain on low lying land under water, and crops on higher lands beaten down by the rain. For more than a week we have had an incessant downpour, and the rain continued to fall with no appearance of clearing up until 22nd. The river Nene, which overflowed its banks two or three days ago, still continued to rise rapidly on Thursday.

Kimbolton, 21st.—Traffic hence to Huntingdon suspended.

Huntingdon, 20th.—The day of the races, but the course was entirely under water.

St. Ives, 21st.—Many houses surrounded by water, and communication only possible by boats.

Earith.—The Ouse has overflowed its banks, and the land is covered with water 3 feet deep.

Somersham.—The embankment of the Great Eastern Railway damaged during the night of 20th.

Bedford, 21st.—Ouse higher than it has been for eleven years, and still rising rapidly; scores of acres by its banks flooded.

Cambridge.—Cam swollen to a great degree, and water running at the backs of the colleges with great velocity.

Waterbeach.—Fields submerged, and hay crops throughout the greater portion of the Fens destroyed.

Swavesey, 21st.—Railway traffic hence to St. Ives stopped.

IV. *Ipswich.*— Large amount of hay spoilt or injured; grain crops much beaten down, so as seriously to affect both the yield and quality.

VI. *Ewias Harold.*—Very heavy storm of rain about 6.30 a.m. on the 20th. About eight o'clock the brook Dulas overflowed, and the village was flooded for a little while, but no serious damage was done.

Ludlow.—The heavy rains of last week overflowed the banks of the Teme and its tributaries in this district, inundating the low-lying fields adjacent, and doing considerable damage to crops.

Tamworth.—The rivers Tame and Anker overflowed, and covered the land for miles round; the bank of the Birmingham canal burst at Fasley at 4 a.m. on 21st.—One of the principal streets had 4 ft. deep of water for a length of 120 yards; two paper mills, a flour mill, and several collieries were flooded, and it was impossible to leave the town on foot except by one road.

Burton-on-Trent.—Very great flood in the Trent, many thousand acres under water. 22nd.—Flood continues, many streets impassable on foot, and the lower stories of hundreds of houses uninhabitable. Dead cattle and much hay passing down the Trent.

Evesham.—In 12 hours the river rose 6 ft.; it was on the 21st evening 9 ft. above the summer level, and still rising.

Kidderminster.—The water in Mill Street was 5 ft. deep at 11 p.m. on 21st. Great damage done; several carpet mills stopped, 20 tons of sugar spoiled at the Co-operative Stores, &c.

Leamington, 21st.—The Leam and the Avon overflowed their banks, washed away a small bridge, and flooded much adjoining land.

Rugby.—All the low-lying land by the river Avon is under water; dead cattle and large quantities of hay are continually passing down the river. The railway flooded and rendered impassable, the engine fires being put out; the damage done is enormous.

Coventry, 21st.—The little river Sherbourne rose rapidly on Tuesday night, and about 5 a.m. on the 21st overflowed its banks, flooded the adjacent lands, and washed away hay, pigs, poultry, &c. The furnace fires of several factories were extinguished.

Nuneaton.—Great flood on 21st; many streets under water, shops and hotels closed, and factory fires extinguished.

Birmingham, 21st.—4 p.m. violent thunderstorm with heavy rain and hail, producing great floods.

VII. *Lutterworth.*—Crops much spoilt; meadows adjoining the Swift are all under water.

Leicester.—Excessive floods on 21st, not only in the town, but throughout the centre of the county; railway bridge washed away at Glenfield; traffic temporarily stopped at Desford, also both E. and W. of Melton.

Glenfield.—Tremendous flood, during the night; the water in part of the village was breast high, and the women and children were conveyed to the Vicarage, Wesleyan chapel, and other buildings on the higher ground.

Barrow (Leicester.)—A man drowned by the inrush of water through the sweeping away of a wall.

Bourn.—Much ballast washed from the railway between here and Essendine, and traffic suspended.

Grantham, 21st.—Witham river has overflowed.

Nottingham.—Much land under water on 21st.

VIII. *Manchester.*—The Irwell was 5 ft. above its usual level at 5 p.m., and 12½ ft. at 11.30 p.m. on 20th. A few cellars flooded.

X. *Newcastle-on-Tyne.*—Much hay damaged by rains of 17th and 18th.

XI. *Usk.*—Hundreds of tons of hay have been carried away by the floods all down the Otway Bottom, as well as several heads of stock.

Llanelly.—The weather in this district continues very bad, and it is feared that many tons of hay will become rotten.

Erwood, near Hay.—The postman being unable to persuade the ferryman to take him across the Wye, determined to swim over, and thus reach the railway for his bags; but his daring was not successful as he was carried 2½ miles down the stream before he could get a landing. Many of the tributaries of the Wye are higher than have ever been known.

Talgarth.—The heavy rain has caused the brooks to overflow, but without damage of any considerable extent.

RAINFALL STATISTICS.

We must now give the details of the fall of rain which has caused these disasters. The table only requires explanation in two respects :—

I. The stations are arranged in the order in which they follow in *British Rainfall*, the names being abbreviated as much as possible in order to save space.

II. The fall on the 14th, and also the total fall for the month at two Monmouthshire stations is followed by a +. This mark, which it always grieves us to use, indicates that at these stations the gauges were allowed to run over, and, therefore, we only know that the fall was greater than that recorded. One, if not both, of the observers was from home, but it is very strange, and greatly to be regretted, that observers so frequently forget to look after their gauges, except at the regular hour of observation, and thus lose facts of extreme practical importance, and locally of great rarity, besides spoiling their own records. We wish that it were possible to make all observers read and obey Rule XVI. of *British Rainfall*, but it is hopeless until they will believe what we have asserted repeatedly, that there is no part of the country where, sooner or later, there will not be a fall of four inches in twenty-four hours.

DAILY RAINFALL IN ENGLAND AND WALES, JULY 13TH—21ST, 1875.

Div.	Initial of County.	Station.	13th	14th	15th	16th	17th	18th	19th	20th	21st	Total in Month.	R began on 14th at
I.	Mid. .	Riversdale	...	1·02	1·09	·09	·38	·30	...	...	·54	4·38	...
		Camden Square...	...	1·29	·93	·27	·16	·07	·03	·02	·43	4·64	11 A.
		Muswell Hill.....	...	1·38	·80	·22	·23	·06	·13	·33	·45	5·20	11½ A.
		Pinner Hill	...	1·23	·63	·07	·33	·04	·06	·18	1·08	5·06	...
II.	Kent.	Riverhead	...	1·23	1·62	·25	·13	·17	·02	...	·34	4·83	...
		Acol	...	·47	·70	·50	·07	...	·23	·28	...	4·09	...
		Forest Hill	...	·83	1·33	·32	·26	·16	·02	...	·30	4·83	11¼ A.
	Sus...	Worthing, B.R...	...	1·37	·18	·05	·24	·01	...	...	·16	2·50	10½ A.
		Swallowfield	...	1·32	1·33	·33	·15	·06	·01	...	·41	5·69	...
		Hailsham	...	·98	·22	·09	·13	·32	...	...	·11	2·71	...
	Ham..	St. Lawrence, I.W.	...	1·83	·31	·07	·35	...	...	...	·18	3·15	..
		Selborne.....	...	2·14	·73	·08	·13	...	·28	...	·51	6·46	...
		StrathfieldTurgiss	...	1·65	·84	·02	·25	·06	·02	·01	1·78	5·70	9½ A.
	Berks	Wantage	·04	1·75	·92	...	·50	·10	·05	·34	·20	4·98	8 A.
III.	Herts	Hitchin	.	·89	·32	·02	·12	·02	·65	·39	·71	6·24	...
	Bucks	Grt. Missenden...	...	1·36	1·10	·12	·15	·08	...	·19	1·62	6·33	...
		Addington.....	...	1·28	·46	...	·09	·08	·12	1·16	·27	4·72	...
	Oxf...	Magdalen Col. ...	·03	1·70	·42	...	·23	·15	·05	·67	·24	4·70	...
		Banbury, H. St..	...	1·36	·39	...	·09	·06	·11	1·56	·17	5·39	9¼ A.
	Nor...	Nort'pton, S.G.S.	..	1·07	·30	...	·04	·35	1·10	1·77	·21	7·17	...
	Beds.	Aspley Guise, O..	...	1·17	·44	·01	·07	·11	·62	1·11	·45	5·69	11 A.
		Sandy Lodge.....	...	1·17	·21	·02	·05	...	·40	1·02	·04	4·56	...
	Cam..	Cambridge, M.V.	...	1·08	·37	...	·02	·03	·68	1·31	·68	4·81	0½ P.
		Wisbeach Obs. ...	...	·86	·56	...	·08	·05	1·40	1·71	·86	7·15	2 P.
IV.	Essex	Sheering	·01	·97	·18	·07	·16	·02	·53	·16	·92	4·15	...
	Suff. .	Hadleigh	...	·82	·28	·04	·08	·01	·53	·98	·60	5·47	...
		Ipswich, B.H. ...	...	1·17	·38	·10	·04	·18	·11	·52	·47	4·42	...
		Bury S. Ed., Cul.	...	·84	·49	..	·02	...	·38	1·05	·98	5·29	...
	Nor...	Diss	...	·84	·42	·01	·02	·13	·08	·65	·68	3·73	3 P.
		Geldeston	...	·50	·35	..	·30	·38	·27	·71	·50	4·13	...
		Worstead	...	·35	·12	...	1·18	·59	·83	2·47	1·91	8·84	...
		Hillington R. ..	...	·62	·42	...	...	...	·40	2·20	1·13	6·90	4¼ P.
V.	Wilts	Pewsey	..	2·45	1·17	·03	·25	...	·19	·03	·10	6·57	...
		Marlboro' Col. ...	...	2·32	·66	...	·28	...	·58	·09	·13	5·60	...
		Compton Bassett.	·03	2·37	·34	...	·38	...	·08	·18	·03	5·63	...
	Dor...	Weymouth, O.L.	·05	2·52	·09	·03	·22	...	·17	...	·04	3·89	..
		Bridport.....	·15	2·70	·05	·01	·21	...	...	...	·09	4·10	...
		Shaftesbury	...	2·15	·45	·04	·18	...	·15	·08	·84	3·91	...
	Dev...	Ashburton, D.H.	·60	3·10	·03	...	·10	...	...	..	·06	5·11	4½ A.
		Teignmouth, B...	·55	2·49	·06	·04	·09	·01	...	...	·01	4·15	...
		Tavistock, K. H.	·69	2·83	·04	...	·12	..	...	...	·01	5·35	...
		Sidmouth, S. ...	·55	1·93	·10	...	·13	...	...	·02	·01	4·10	4 A.
		Okehampton	·20	·92	·16	·04	·15	...	...	·11	·15	3·02	...
		Torrington, L.W.	·52	1·33	·03	·06	·11	·01	...	...	...	3·50	...
		Barnstaple.....	·58	1·21	·02	·02	·21	...	...	...	·02	3·35	...
		Lynmouth...	·12	1·15	·22	·12	·17	·03	...	...	...	3·35	...
	Cor...	St. Austell, T. ..	1·12	1·16	·01	...	·07	·07	...	...	·03	3·47	...
		Bodmin, C.S.....	·86	1·36	...	...	·08	·12	·06	...	·08	3·58	...
	Som..	Taunton, Hove T.	·17	1·57	·42	...	·10	...	...	·02	·10	4·18	...
		Burnham	·30	1·60	·17	...	·33	·01	·03	·03	·15	4·69	4 A.
		Frome, M.R.....	·10	2·64	·78	·21	...	...	·27	·03	·05	6·43	...
VI.	Glo...	Clifton, S.P.....	·06	2·90	·15	...	·30	...	·13	·08	·44	5·99	6 A.

Div.	Initial of County.	Station.	13th	14th	15th	16th	17th	18th	19th	20th	21st	Total in Month.	R began on 14th at
VI.	Glo..	Berkeley	·06	2·40	·16	·01	·35	..	...	·26	·18	5·03	...
		Stroud, U.	·09	2·36	·20	...	·26	·01	...	·45	·86	5·33	...
		Frampton-o-S. SL	...	1·94	·15	·01	·26	·01	..	·27	·43	4·43	...
		Staunton	...	2·75	·18	..	·18	·01	·02	·77	·43	6·73	7¾ A.
	Here.	Ross, Rocklands..	·01	3·36	·60	...	·36	·01	...	·30	·62	7·02	...
		Longtown	·21	3·88	·82	...	·20	...	·70	...	...	7·21	6½ A.
	Shr..	Ludlow, M.S. ...	...	2·00	·42	·01	·02	·03	·08	·73	·08	4·69	8½ A.
		Shifnal, H.H. ...	...	1·24	·42	...	·06	·11	·37	1·32	·03	5·59	...
		Wem, Sansaw ...	·28	1·36	·50	...	·30	·10	·32	1·10	·02	6·74	...
	Sta..	Wolver'pton, M.R	...	1·19	·38	...	·11	·66	·45	2·79	·03	8·14	11 A.
		Tamworth	·01	1·00	·66	·02	...	·51	·54	2·40	·57	8·26	...
		Cheadle, H. H....	·01	1·38	·22	...	·02	·04	1·18	·45	·04	6·97	...
	Wor..	Tenbury, O.	·01	2·15	·92	...	·06	·05	·08	·89	·08	6·17	7½ A.
		Evesham	...	1·40	·26	...	·10	·11	·85	1·22	·23	5·02	...
VII.	Lei....	Leicester, B. V. .	...	1·07	·27	...	·02	·16	·62	2·22	·41	6·54	...
		Melton, C. R. ...	...	1 13	·50	...	·01	·19	1·28	2·30	·37	7·78	Noon.
	Lin...	Boston	...	·72	·36	...	·20	·18	·46	·56	·17	3·82	...
		Horncastle, B. ...	...	·42	·05	...	·35	·04	·35	·68	·15	3·65	...
		Louth Calce... ...	·02	·28	·01	...	1·36	·20	·71	·69	·43	5·23	...
		Ulceby, K.	·05	·16	·01	...	·96	·57	·66	·38	·16	4·38	...
	Not..	Mansfield, G. H..	·01	·76	·35	...	·28	·19	·66	·25	·41	4·28	...
VIII.	Lanc.	Liverpool, W-o-H	·09	·30	·01	...	·14	...	1·07	·39	...	4·33	...
		Broughton-in-F. .	...	...	...	...	·07	·44	·20	·21	...	3·71	...
IX.	York.	Halifax, M. O....	·04	·13	...	...	1·18	·07	·70	1·75	·05	5·73	...
		Wakefield, S.V...	·07	·16	·01	.	·77	·15	·57	·56	·22	4·08	...
		Arncliffe	·06	·04	...	..	·16	·34	·41	·08	·14	4·91	...
X.	Nor...	N. Shields, R.P..	·03	...	...	...	·48	·61	1·22	...	..	5·38	...
	Cum..	Seathwaite.....	·20	...	...	...	·52	·43	·73	...	...	5·15	...
	West.	Elterwater, W....	·06	...	...	...	·10	·42	·57	·20	...	4·32	...
XI.	Mon..	Newport, Springf.	·15	5·30	·12	...	·36	...		·07	·51	7·89	5½ A.
		,, W.W..	...	5·33	...	...	...	...	...	...	...	...	...
		Llanfrechfa, G....	·32	3·70+	·37	..	·29	.	...	·03	·52	6·84+	...
		Caerleon, L.	·07	4·64	·29	·03	·19	·01	...	·05	·50	7·68	...
		Chepstow, P.P....	·02	4·20+	·54	...	·42	...	·04	...	·55	7·53+	6 A.
		Llangibby Cas....	·04	3·65	·26	...	·35	·01	...	·05	·56	6·88	...
		Tintern Abbey ...	·08	5·31	·60	...	·22	...	·11	·31	·70	9·57	...
		Monmouth	·29	2·75	·47	...	·30	...	·20	...	...	6·03	7 A.
		Abergavenny, L..	·13	3·88	·33	...	·21	·01	...	·07	·21	6·08	...
	Glam.	Cowbridge, T.H..	·50	2·42	·75	...	·26	·05	...	·09	...	5·48	...
		,, Ash H.	·15	3·67	·19	...	·33	...	...	·02	·02	6·16	...
		Cardiff Cem.	·25	4·70	·35	...	·60	...	·01	·03	·20	8·04	...
		,, Crock. ...	·32	3·74	·20	...	·55	·01	·01	·03	·16	6·28	...
		,, Pentyrch.	·32	4·80	·30	...	·51	...	..	·02	...	7·22	..
		Swansea, S.D.L. .	·48	1·50	·03	...	·14	·01	...	. .	·01	3·82	...
		Aberdare, Tre. ...	·29	3·85	·22	...	·34	...	...	...	...	8·14	...
		,, Mardy ...	·21	3·56	·10	·14	·11	·02	·04	·03	..	6·15	...
		,, Abernant	·20	3·30	·34	·18	...	...	...	·10	·08	6·37	...
		MerthyrTydfil,TT	·22	3·00	·24	...	·20	...	·24	·11	...	5·61	...
		Ystalyfera	·90	2·00	...	...	·35	..	...	...	...	6·30	4 A.
	Car...	Carmarthen, JCA	·36	2·77	·12	...	·15	·03	...	...	..	6·40	...
	Pem..	Tenby, I. T.	1·36	3·31	·17	...	·24	·07	...	...	...	7·02	1 A.
		Haverfordwest ...	·97	2·41	·13	...	·33	·05	...	...	...	5·50	..
	Card..	Aberystwith, Gogi	·14	1·15	·02	...	...	...	...	·19	·13	4·47	...
		,, Gogerddan	·04	1·40	·01	...	·05	...	..	·19	·03	4·44	...
	Brec..	Brecknock	·39	1·00	·41	·20	...	...	·20	·21	·10	4·17	...
	Rad. .	Rhayader, Nant..	·04	3·68	·19	...	·04	·01	·03	·17	·21	7·26	8½ A.

The above table requires no praise at our hands, the observers have as usual done their work well, and they have, with their accustomed readiness, furnished the data we required.

We need only summarize the leading features, and that with the utmost brevity :—

(1.) A steady rain set in at Tenby, in Pembrokeshire, about 1 a.m. on July 14th; it was then fine at all other stations in England and Wales; hour by hour it extended E.N.E.ward, at an average rate of about 17 or 18 miles per hour, reaching Gloucester about 8 a.m., Leicester about noon, and extending to the N.E. of Norfolk by 4 p.m.

(2.) The duration of this rain was variable, but perhaps on the average about 36 hours, and during that time it was persistent and steady, rather than violent.

(3.) As the rain began at the Welsh and Devonshire stations before 9 a.m. on 14th, part of the fall was necessarily entered to the 13th, and as at the majority of stations it had not finally ceased by 9 a.m. on 15th, it is most expedient to group the three days together, and thereby eliminate differences due solely to the easterly progression of the rain. Grouping them thus, we find—

I. All stations north of Lat. 53° had less than 1 inch of rain.
II. „ „ south „ 53 „ more „ „
III. „ „ west of a line from Selsea Bill to Sheppey, thence N.W. to Shrewsbury, and then S.W. to Cardigan, had more than 2 inches (except stations in N. Devon).
IV. All stations in Monmouthshire and E. Glamorganshire, had more than 3 inches, while fourteen stations in that district had more than 4 inches, and six stations had more than 5 inches.
V. It is curious to observe the great difference on the two sides of the Lower Severn, for while the Monmouthshire stations had the enormous average of about 5 inches, the fall in Gloucestershire was not much more than half that amount.

(4.) On the 17th there were heavy rains in various parts, but no exceptionally heavy amounts, the largest yet reported being Calcethorpe, Louth, 1·36, and Moorside, Halifax, 1·18.

(5.) On the 18th there was rain in different parts, but no fall of 0·70 in.

(6.) On the 19th there were thunderstorm rains in the Midland Counties, and especially in the Fen districts; upwards of an inch was registered in the following counties: Northampton, Suffolk, Cambridge, Stafford, Leicester, Lancashire, and Northumberland.

(7). On the 20th, more than an inch of rain fell at stations within a line passing from Ipswich to Oxford, thence to Shrewsbury and past Grantham to Ipswich again. The heaviest falls were 2·40 in. at Tamworth, and 2·79 in. at Wolverhampton.

(8.) On the 21st, falls exceeding 1 inch occurred in N. Middlesex, N. Hants, S. Bucks, and N. Norfolk.

(9.) Finally we find that the Monmouthshire floods were the direct product of the rainfall described in clauses (1,) (2,) and (3) ; and that the injury in central England arose from the heavy rains of the 17th to the 20th inclusive, which, finding the ground soaked, and the streams filled by the rainfall of the 14th, were necessarily obliged to flood low-lying lands.

(10.) As to the damage, it is hardly for us to speak. The dry weather at the end of July was undoubtedly of enormous value —probably worth millions—but no amount of sunshine will restore lost lives, dead cattle, broken reservoir dams, shattered houses, hay which has been washed away or furniture and stock-in-trade which have been spoiled. Good may come out of evil, but there are many who will long remember with regret the floods of July, 1875.

We have been favoured with voluminous details and remarks on the rainfall of this extraordinary period, but at present have only room to print the following :—

To the Editor of the Meteorological Magazine.

SIR,—Knowing the interest you take in Rainfall Statistics, I beg to forward you an account of the unprecedented amount of rain that has fallen in East Anglia during the present month.

The amount that I have registered from my gauge (8 inches in diameter) during the six months ending 30th of June, was only 7·97 in. The quantity registered during the present month up to the morning of the 21st *inclusive*, amounts to the extraordinary quantity of 7·90, being just equal to the aggregate of the preceding six months. At 9 a.m. on the 21st instant, my gauge indicated 3·95 inches. I have never heard of so large an amount being registered in 24 hours in this part of England.

The rain continued with slight intermissions till this morning, when I registered 0·83, making in two consecutive days a total of 4·78 in.

Great damage has been done to the crops, and all the low-lying lands are inundated.

It is rather remarkable that during the great rainfall of the last two days, there was no thunder and lightning, and the barometer was stationary during the week at about 29·40 inches.

I am, yours truly,

W. H. COZENS-HARDY.

Letheringsett Hall, Norfolk, 22nd July, 1875.

To the Editor of the Meteorological Magazine.

SIR,—You are welcome to the enclosed measurements if you think them of use as an example of the rise of a river in a flat country like Oxfordshire in connection with the rainfall. A systematic register of other rivers might be useful. I keep also the temperatures on surface

and 3 ft. below, read each morning; but the numbers would load the enclosed table too much.—I am, yours truly,

EDWARD CHAPMAN.

Frewen Hall, Oxford, 5th August, 1875.

Measurements of River Cherwell during Floods, July, 1875.

Date.	Hour.	Rise in ·1th of a foot.	Fall.	Rain measured.	REMARKS.
July 1-13	...	..	...	1·10	
14	...	...	...	1·70	Rain measured at 10 a.m. on 15th
15	3.45 p.m.	0·000	...	·42	Gauge placed in River 7 ft. 4 in.
	5.50	·100	...		above surface.
16	10 a.m.	·400	...		
	12.30 p.m.	·100	...		
	4.30	·025	..		
17	10 a.m.	·175	...	·23	
	12.30 p.m.	·050	...		
	6.30	·075	...		
18	2 p.m.	·075	...	·15	
19	10 a.m.	·150	...	·05	Water fell ·05 at 5 o'clock.
20	10 ,,	·000	..	·67	Water rose ·05 at 2.30 p.m.
21	10 ,,	·275	...	·24	
	2 p.m.	·025	...		
22	12 noon	·350	...		
23	10 a.m.	·600	...	·01	
	3 p.m.	·500	...		
	5 ,,	·150	...		
	8 ,,	·150	...	...	Total rise from July 15th, 3ft. 2in
24	10 a.m.	...	·100	·02	
	2 p.m.	...	·050		
	7 ,,	...	·100		
25	10 a.m.	...	·250	·11	
	4 p.m.	...	·075		
26	10 a.m.	..	·175		
	5 p.m.	..	·100		
27	10 a.m.	...	·250		
	6 p.m.	...	·100		
28	10 a.m.	...	·200		
	8 p.m.	...	·200		
29	10 a.m.	...	·150		
30	10 ,,	...	·300		
	5 p.m.	...	·150		
31	10 a.m.	...	·200		
			2·400		
				4·70	Total Rain for Month.

The flood was about as high as an average winter flood.

To the Editor of the Meteorological Magazine.

SIR,—I hasten to send you particulars of the fearful rainfall of yesterday (July 20th), which, commencing at 4 p.m. lasted until 3 a.m. in the morning, and which reached the enormous quantity of 2·40 inches; the result is most disastrous in this district. The rivers Tame and Anker, already in a state of flood from the previous rains,

are now higher than they have been since the flood of October, 1852. An immense area of grass land is under water, and the cornfields, in many cases, are in the same miserable condition. The banks of the Coventry Canal, at Hazeley, about a mile south of here, burst early this morning, and a huge volume of water was discharged, but without doing any serious damage; it is now being repaired. I enclose you statements of the rainfall of the last 24 days, which is quite unprecedented, as far as I know.

The lower streets of the town of Tamworth are under water.

I am, dear Sir, yours very truly,

WILLIAM ARNOLD.

Lichfield Street, Tamworth, 21st July, 1875.

RAINFALL AT TAMWORTH, STAFFORDSHIRE.

From June 27th, to July 20th, 1875.

June	27th	0·49	July	10th	0·16
,,	28th	—	,,	11th	0·35
,,	29th	1·00	,,	12th	—
,,	30th	0·39	,,	13th	0·01
July	1st	—	,,	14th	1·00
,,	2nd	0·40	,,	15th	0·66
,,	3rd	0·47	,,	16th	0·02
,,	4th	—	,,	17th	—
,,	5th	—	,,	18th	0·51
,,	6th	—	,,	19th	0·54
,,	7th	—	,,	20th	2·40
,,	8th	0·06			———
,,	9th	0·57			9·03

Average Rainfall of the Year, 24·00.

REMARKABLE SHOWER OF HAY.

To the Editor of the Meteorological Magazine.

SIR,—You may care to insert in the *Meteorological Magazine* the enclosed cutting from the *Dublin Daily Express*, of Wednesday, July 28th. The fall of grass or hay was observed at Dean's Grange, Monkstown, more than a mile south of the place where Dr. Benson noticed it. My rainfall for July has been 2·751 inches on 18 days; max. in 24 hours was ·506 on the 14th, very different from your great fall.—Yours very truly, J. W. MOORE.

40, *Fitzwilliam Square West, Dublin, July* 31, 1875.

"SIR,—In connection with the great and wide-spread meteorological disturbances which have occurred of late in these and other countries, the following will not be devoid of interest to some of your readers who may not have seen the unusual phenomenon which I am about to describe.

"About half-past nine o'clock this morning, as I was standing at a window facing the east, in Monkstown, my attention was called by the Rev. T. Power to a number of dark flocculent bodies floating slowly down through the air from a great height, appearing as if falling from a very heavy, dark cloud, which hung over the house. On going to the hall door, a vast number of these bodies were discerned falling on all sides, near and far, to as great a distance as their size permitted them to be seen—over an area whose radius was probably between a quarter and half a mile. Presently, several of these flocks fell close to my feet.

On picking up one, it was found to be a small portion of new hay, of which I enclose a sample. When it fell it was as wet as if a very heavy dew had been deposited on it. The duration of this phenomenon, from the time my attention was first called to it till it had entirely ceased, was about five minutes, but how long it may have been proceeding before this I cannot tell.

"The flocks of hay, from their loose, open structure, made a large appearance for their weight, but the average weight of the larger flocks was probably not more than one or two ounces, and, from that, all sizes were perceptible down to a single blade. There was no rain from the dark cloud overhead, though it had a particularly threatening appearance at the moment of observation. The air was very calm, with a gentle under-current from S.E. The clouds were moving in an upper-current from S.S.W.

"My friend, Dr. J. W. Moore, has kindly supplied me with the following particulars as to the state of the weather in Fitzwilliam Square, at 9 o'clock a.m., half an hour before the above observations were made :—

"'The barometer, corrected and reduced to 32 deg. at sea level, read 30·342in. The air was tolerably warm and dry, the dry-bulb temperature being 60 deg., and the wet-bulb temperature 54·3 deg. ; the dew-point 49·4 deg., and the percentage of humidity 69. A slight S.E. breeze was blowing, while rather heavy cirro-cumuli and cumuli were floating in an upper current from S.S.W.

"'The coincidence of a hot sun and two air currents probably caused the development of a whirlwind some distance to the south of Monkstown. By it the hay was raised into the air, to fall, as already described, over Monkstown and the adjoining district.'—I am, Sir, yours truly, "J. HAWTREY BENSON."

"90, *Lower Baggot Street, July* 27, 1875.

REVIEW.

Handbook for South Africa, including the Cape Colony, the Diamond Fields, and the Trans-Orange Republics, with a new Map and a Gazetteer. S. W. Silver & Co., "Colonies" Office, London, 1875. Cloth 8vo.

THE publishers have evidently resolved to spare neither trouble nor money in making their series of Handbooks upon the various colonies, the most exhaustive works which it is possible to compile. The present work, though still "handy," reaches beyond 500 pages, and really is a worthy successor to Silver's Australia and New Zealand—we could hardly give it higher praise. The only thing which we do not thoroughly like is the author's style, which is not so easy or pictorial as that of the author of *Australia*, indeed we rather wonder that it has been possible for the author to give us so many facts as he has done, and yet to leave us with a hopeless haziness of impression respecting the places which he has described. To any one going to, or interested in, South Africa this book will be of extreme utility as a book of reference, which its good index, good map, and good gazetteer will facilitate; but it certainly cannot rank with Australia for pleasantness of reading.

The chapter on Scenery and Climate is perhaps written the best, and the first two or three pages are quite descriptive, but the usual level is soon reached, although many of the facts recorded are very striking.

JULY 1875.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1860–5	Greatest Fall in 24 hours. Dpth	Date.	Days on which .01 or more fell.	TEMPERATURE. Max. Deg.	Date.	Min. Deg.	Date.	No. of Nights below 32°. In shade	On grass
			inches	inches.	in.								
I.	ENGLAND.	Camden Town	4·64	+ 2·85	1·29	14	17	80·4	28	42·5	13	0	0
II.		Maidstone (Linton Park)	5·60	+ 3·62	1·45	16	17	81·0	29	45·0	13	...	...
,,		Selborne (The Wakes)	6·46	+ 4·26	2·14	14	16	73·5	29	38·5	27	0	0
III.		Hitchen	6·24	+ 4·34	2·06	3	16	71·0	18	42·0	12	0	...
,,		Banbury	5·39	+ 3·33	1·56	20	14	76·0	29	40·0	26	0	...
IV.		Bury St. Edmunds (Culford)	5·29	+ 3·30	1·05	20	14	76·0	29	41·0	25	0	0
V.		Bridport	4·10	+ 1·99	2·70	14	13	75·5	28	36·0	11	...	..
,,		Barnstaple	3·35	+ ·49	1·21	14	15	82·0	30	48·0	26	...	...
,,		Bodmin	3·58	+ ·47	1·36	14	16	74·0	28	46·0	27	0	0
VI.		Cirencester	5·56	+ 3·12	3·11	14	13	...	...	...	...	...	...
,,		Shifnal (Haughton Hall)	5·59	+ 3·42	1·32	20	18	74·0	29	42·0	26	0	0
,,		Tenbury (Orleton)	6·17	+ 3·79	2·15	14	19	77·8	29	39·0	26	0	0
VII.		Leicester (Belmont Villas)	6·54	+ 4·44	2·22	20	16	79·0	18	42·8	13	...	...
,,		Boston	3·82	+ 1·52	·72	14	15	80·0	29	42·0	13	...	...
,,		Grimsby (Killingholme)	4·38	...	·96	17	19	70·0	1, 2	45·0	13	0	...
,,		Derby	...	...	...	...	...	...	...	...	...	...	...
VIII.		Manchester	4·60	+ 1·91	1·06	19	14	82·0	29	41·8	31	...	...
IX.		York	3·05	+ 1·11	·63	15	15	...	...	...	...	...	...
,,		Skipton (Arncliffe)	4·91	+ 1·68	1·80	1	19	77·0	6	35·0	12	0	...
X.		North Shields	5·38	+ 3·57	1·22	19	12	71·0	29	44·0	26	0	..
,,		Borrowdale (Seathwaite)	5·15	— 2·99	·82	8	12	...	...	..	...	...	...
XI.	WALES.	Cardiff (Ely)	8·04	+ 4·89	4·70	14	16	...	...	...	...	...	...
,,		Haverfordwest	5·50	+ 2·20	2·41	14	15	75·5	...	40·0	26	...	...
,,		Rhayader (Cefnfaes)	...	...	.	..	...	...	...	..	...	...	...
,,		Llandudno	3·47	+ 1·18	1·12	14	15	77·0	29	47·2	13	0	0
XII.	SCOTLAND.	Dumfries (Crichton Asylum)	3·00	+ ·75	·59	9	16	78·0	8	40·2	26	0	0
,,		Hawick (Silverbut Hall)	2·54	...	·66	18	11	...	...	...	...	...	...
XIV.		Kilmarnock (Annanhill)	2·15	...	·70	18	9	74·0	22	41·7	16	...	...
XV.		Castle Toward	2·35	— ·79	1·20	19	8	77·0	21	...	...	...	...
XVI.		Leven (Nookton)	2·91	+ ·64	·74	10	16	78·0	7	40·0	26	0	1
,,		Stirling (Deanston)	...	...	...	...	...	..	...	...	..	...	...
,,		Grandtully	1·88	...	·54	19	9	...	...	..	...	...	...
VII.		Braemar	3·53	+ 1·25	·78	23	17	76·0	5	35·2	13	0	1
,,		Aberdeen	3·69	...	..	...	16	71·6	5	38·5	13	0	0
VIII		Loch Broom	4·77	...	·78	22	16	...	...	...	...	...	..
,,		Portree	3·70	— 2·37	·67	29	20	...	...	...	...	...	...
,,		Inverness (Culloden)	3·33	+ ·66	1·35	24	19	74·0	7	39·0	15	0	0
XIX.		Helmsdale	2·26	...	·63	1	11	...	...	...	...	...	...
,,		Sandwick	2·96	+ 1·07	·66	11	13	70·3	21	41·2	14	0	1
XX.	IRELAND.	Caherciveen Darrynane Abbey	2·04	...	·70	12	6	...	...	...	...	...	...
,,		Cork	1·96	...	·60	17	12	...	...	...	...	...	...
,,		Waterford	3·80	+ ·48	1·12	14	12	75·0	7, 8	44·0	27	0	0
,,		Killaloe	...	...	...	...	...	.	...	...	...	..	...
XXI.		Portarlington	2·27	— 1·27	·55	19	20	74·0	28	41·5	16	0	...
,,		Monkstown, Dublin	2·49	+ ·06	...	...	...	...	...	...	...	...	...
XII.		Galway	...	...	...	...	...	...	...	...	...	...	...
,,		Ballyshannon	3·15	...	·50	9, 10	19	...	...	...	...	...	...
XIII		Waringstown	4·29	...	1·10	10	17	81·0	7	38·0	25	0	0
,,		Edenfel (Omagh)	2·39	...	·83	10	16	73·0	28	34·0	25	0	1

+Shows that the fall was above the average; —that it was below it.

METEOROLOGICAL NOTES ON JULY.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

LINTON.—A month memorable for its heavy rainfall, 2·40 in. falling on the 15th and 16th; very little T, except on 3rd and 11th; winds variable, our heaviest rainfall being from N.E.; very little sun, except in the last week, which was dry and fine. A disastrous month to the fruit grower, large quantities being spoiled by the rain, but other crops not so seriously so with us as in other places. Altogether it has been the wettest July for upwards of 20 years, and the 2·40 rain noted above has not been equalled by any two consecutive days during that period.

SELBORNE.—Dense fog on 18th; fog, heavy R and T at 2 p.m. on 19th; heavy R and T at 3 p.m. on 22nd, and on early morning of 23rd. An exceedingly cold, wet, ungenial month; much hay spoiled; hops and corn recovering towards the end of the month; rainfall 4·34 in. in excess of (13 years) average.

HITCHIN.—The wettest and coldest July since we commenced observations in 1849; 2·06in. fell on 3rd, of which 1·57 fell in four hours.

BANBURY.—Little whirlwinds on 25th at 11.45 a.m., wisps of hay carried over the town at a great height (¼ of a mile?) from a rick which was being made in a field ½-a mile out of the town, some of it was carried to Warksworth, two miles E., and some fell in the town.

CULFORD.—T on 3rd, 11th, and 22nd; the rainfall much above the average, and the weather has been cold for the season, the mean. temp. being the same as the month of June, viz., 59°·3; westerly winds prevailed during 25 days, and easterly ones on six.

BRIDPORT.—Heavy floods on 14th and 15th.

BODMIN.—Average bar. during the month, 29·98; mean. temp., 61°·5; rainfall 0·44 in. above the average (26 years).

HAUGHTON HALL, SHIFNALL.—The wettest July (5·59) for 41 years, the nearest approach was in 1853, when 4·06 fell; the temp. of the month was consequently far below the average, especially in the nights, three of which only reached 55°, and only four days were above 70°; the rainfall of 14th and 15th continued for 45 hours, amounting to 1·66; bar. was low, though steady, throughout, highest on 28th, and lowest on 11th; T in distance on 1st, 8th, 22nd, 23rd, and 25th, none of it near, wind varying throughout from all quarters. Swedes dwindling and unhealthy from the R and cold; mangold wurzel flourishing; much hay spoiled, and old hay now above £10 per ton; few butterflies, and, as yet, no wasps.

ORLETON.—Much R on 1st, 2nd, and 3rd, then four fine, dry days, followed by R almost every day till the 24th; the remainder of the month was fine and pleasant; the quantity of R that fell this month (6·17) has only been exceeded three times in July during 45 years, viz., in 1834, 9·225 in, in 1855, 6·530, and in 1861, 6·690 in., in no other July has the quantity registered reached 4·500 in. Faint, distant T, was frequently heard, but there was no TS, and no violent R. The grain crops are sadly beaten down, nevertheless. The temp. of this month was more than 2°·5 below the average.

LEICESTER —More R has fallen in July (6·54) than in any month since I began to register in March, 1860. The last week was fine.

BOSTON.—Temp. of month 3°·3 below the average; great prevalence of Polar winds.

GRIMSBY.—A cold, wet month. In July, 1872, more rain fell in 12 days than has fallen this year in 19, but the heavy rainfall of the last two days of June (1·80) added to this month's rainfall, has made the ground colder and wetter than it was in 1872. We are not subject to floods, but it is feared that the wet has injured the quality of the corn, and endangered the potato crop. TS in early

morning of 18th ; T from 10.30 to 11.30 a.m. on 19th ; dense fog early ; gossamer on 29th—a pretty sure sign of fine weather.

ARNCLIFFE.—1·70 fell between 3 p.m. and 6 p.m. on the 1st during a TS.

NORTH SHIELDS.—T on 2nd ; TS, 11th, 18th, 19th, 20th, and 23rd ; on the 19th 1·22 in. of R fell. ·50 in. fell in half an hour on 2nd.

SEATHWAITE.—Not one day on which 1 in. was measured, ·82 in. on the 8th being the max.

WALES.

HAVERFORDWEST.—Cool throughout, the temp. reached 70° only on five days ; showery and cold 1st to 3rd, and more or less so from 8th to 11th. Great storm from the S.E. with a deluge of R on 14th ; after this, with two or three exceptions, the rest of the month was fine, but remarkably cool. The damage from the storm was much less than expected, neither did the floods correspond with the heavy downpour, little trace remaining after 24 hours.

LLANDUDNO.—A slight TS on 2nd. Notwithstanding a mean temp. 1°·5 below, and a rainfall greatly above the average, there was a large amount of sunshine, and 16 very fine days in the month, which was at the same time characterized by a remarkable absence of sickness. With the exception of the heavy R (1·12 in.) that fell on the 14th, there was nothing unusual in the monthly rainfall.

SCOTLAND.

DUMFRIES.—The fall is below the average, and was pretty equally distributed over the month ; the prevalent winds during the R have been from the N. and E., rather unusual at this season of the year ; there were no heavy falls, and only one TS ; temp. 1°·5 higher than last year.

HAWICK.—A month of beautiful weather ; TS on 1st.

ANNANHILL.—Month generally fine ; TS on 1st, 2nd and 19th ; foliage full and healthy, and pastures good ; harvest prospects promising ; hay, average crop ; cereals looking well ; agricultural reports generally favourable ; potatoes good, no symptom of disease.

CASTLE TOWARD.—The month all that could be desired, the weather so dry that all out-door work is pushed forward ; hay carried in splendid condition ; corn in fine ear ; potatoes capital, and no signs of disease ; currant and gooseberry crop splendid ; apples and pears not quite so large as expected.

BRAEMAR.—T 7 p.m. on 19th ; fine meteor on 21st ; rather a cold, sharp month ; hills partially covered with fresh S on 12th, 13th, and 14th.

LOCHBROOM.—A very fine month ; the R curiously fell in three divisions or plumps, with beautiful weather between.

PORTREE.—A very fine month ; crops all looking very well ; hay harvest almost all secured.

SANDWICK.—A very pleasant month ; temp. at or above 60° on 14 days ; vegetation made rapid progress.

IRELAND.

DARRYNANE.—Very fine month, latter part of the month hot.

BALLYSHANNON.—On the whole a summer-like month, though the frequent showers have interfered with the hay harvest ; potato crop generally good, but not quite free from disease, which generally comes with warm damp weather.

OMAGH.—Weather, though cood, very favourable to the crops. There has not been for many years so fair a prospect of an abundant harvest as this year ; a remarkable depression of temp. on night of 25th, when ice was formed in low damp situations.

SUPPLEMENTARY TABLE OF RAINFALL IN JULY, 1875.

[For the Counties, Divisions, Latitudes, and Longitudes of these Stations, see Met. Mag., Vol. X., p. 28.]

Station.	Total Rain.	Station.	Total Rain.
	in.		in.
Acol	4·09	Stanley, Wakefield	4·08
Hailsham	2·71	Gainford	4·29
Strathfield Turgiss	5·70	Shap	3·27
Addington Manor	4·72	Llanfrechfa	8·44
Oxford	4·70	Castle Malgwyn	3·82
Cambridge	4·81	Heyope	...
Sheering	4·15	Melrose	3·15
Ipswich	4·42	Cessnock, Glasgow	1·26
Diss	3·73	Gruinart	...
Swaffham	7·00	Keith	5·09
Compton Bassett	5·63	Strathconan	4·77
Hessary Tor, Dartmoor	9·07	Springfield, Tain	3·58
Teignmouth	4·15	Skibbereen	0·95
Torrington	3·50	Fermoy	2·16
Trevarrick, St. Austell	3·47	Kilrush	2·41
Taunton	4·18	Kilkenny	4·05
Burnham	4·69	Kilsallaghan	2·86
Cheadle	6·97	Twyford, Athlone	2·11
Ashby de la Zouch	6·84	Ballinasloe	2·19
Coston, Melton Mowbray	7·78	Kylemore	4·23
Bucknall	3·65	Bangor	3·29
Mansfield	4·28	Carrick on Shannon	1·96
Walton, Liverpool	4·33	Warrenpoint	3·20
Broughton-in-Furness	3·71	Bushmills	2·05

A SINGULAR PHENOMENON.

To the Editor of the Meteorological Magazine.

SIR,—On Friday evening, June 25th, between 9 and 10 o'clock, I observed in the E.S.E. very frequent flashes, or rather very narrow streaks, of a pale blue colour keep darting up from the earth towards the heavens, something like those of an Aurora Borealis. The day had been rather dull, hot, and close, and there had been distant thunder. I merely went out to see if I could discern any sheet lightning, but saw the above instead. In the E.S.E. it was rather dark, but overhead and everywhere else it was clear and starry. Can you, or any of your readers, throw any light upon the subject, or give me some information as to what it was, or what may have been the cause of it? I remain, yours faithfully,

CHARLES GAPE.

Rushall Vicarage, Scole, Norfolk, July 15th, 1875.

[Having asked the writer of the above letter certain questions, he has been kind enough to reply as follows.—ED.]

"I have examined local papers and made enquiry, and cannot find there were any displays of fireworks at all. The appearance did not at all resemble fireworks, but seemed much more like some meteoric disturbance.

Rushall Vicarage, Scole, July 29th, 1875."

SYMONS'S
MONTHLY
METEOROLOGICAL MAGAZINE.

CXVI.] SEPTEMBER, 1875. [PRICE FOURPENCE, or 5s. per ann. post free.

THE BRITISH ASSOCIATION AT BRISTOL.

ALTHOUGH Prof. Balfour Stewart's address was one of the best ever delivered, the Meteorological papers (using the term in its strict sense) at the late meeting were not above the average, either in number or in quality. As, however, we hope to print abstracts of them all, it is unnecessary to criticize them.

The Meteorologists present included the following :—

Belcher, Adml. Sir E., K.C.B.
*Black, Surgeon-Major, W. T.
Blake, W.
Brady, Sir Antonio, Kt., F.G.S.
*Burder, G. F., M.D.
Bush, Clement
Clegram, W. B., C.E.
*Dines, G.
*Dowson, E. T.
*Dymond, E. E.
Elliot, Robert, F.R.S.E.
Elliot, Sir Walter, K.C.S.I., F.L.S.
Enniskillen, The Earl of, D.C.L., F.R.S.
*Everett, Prof. J. D., M.A., D.C.L.
*Field, Rogers, B.A., C.E.
Galton, F., F.R.S., F.G.S.
Gamble, J. G., B.A.
*Glaisher, J., F.R.S.
Hector, Dr. J., F.R.S.
Hennessy, Prof. H., F.R.S.
Herschel, Prof. A. S., F.R.A.S.
Knight, Rev. R. J.
Longman, W.
Lund, C.
McCullough, Dr. D. M.
*McLachlan, R., F.L.S.
Main, Rev. R., F.R.S.
Matthew, Rev. J.
*Muirhead, H., M.D.
*Narayan, N., C.E.
Nash, A. S.
*Ormerod, G. W.
*Osler, A. F., F.R.S.
Parkes, W.
Pengelly, W., F.R.S.
*Perry, Rev. S. J., F.R.S., F.R.A.S
*Rawson, Rawson W., C.B.
Rodwell, G. F.
*Smyth, J., junr., M.A.
Sopwith, Thos., M.A., F.R.A.S.
*Stewart, Prof. Balfour, M.A., F.R.S.
Strange, Lt.-Col. Alexander, F.R.S.
*Symons, G. J.
Talmage, C. G., F.R.A.S.
*Tomlinson, Charles, F.R.S.
Toynbee, Captain H.
Tuckett, F. F.
Vivian, E.
*Walter, A. W.

The "Meteorological Breakfast," inaugurated at Belfast, was well attended at Clifton, and included all the gentlemen above-mentioned to whose name an asterisk is prefixed.

The following are titles of all the papers upon, or bearing upon, Meteorology :—

Prof. W. F. Barrett—On a self-registering rain gauge.
Dr. J. Croumbie Brown.—South African Torrential Rivers.
" " " —The late Inundations in France in reference to Forest Clothing of the Mountains.

Dr. W. B. Carpenter—Bearings of Recent Observations on the Doctrine of Oceanic Circulation.

Jas. Croll.—The Wind and Gravitation Theories of Oceanic Circulation.

Professor Everett.—Report of the Underground Temperature Committee.

James Glaisher.—Report of the Committee on Luminous Meteors.

Professor Hennessey.—On the Influence of the Physical Properties of Water on Climate.

Professor Hennessey.—On the possible Influence on Climate of the Substitution of Water for Land in Central and Northern Africa.

Dr. J. Janssen.—On Mirage at Sea.

Professor W. Stanley Jevons.—On the Influence of the Sun-spot Period upon the Price of Corn.

N. Lowenthal Lonsdale.—Mechanical Self-registering Apparatus for Barometer, Thermometer, Rain and Wind Gauges.

Rev. R. Main.—List of Meteors observed at Oxford.

A. Malloch.—On a mode of Producing a Sharp Meridian Shadow.

C. Meldrum.—Letter on Rainfall Periodicity.

T. Moffat.—On the apparent Connection between Sun-spots, Atmospheric Ozone, and Force of Wind.

Professor Osborne Reynolds.—On the Refraction of Sound by the Atmosphere.

G. J. Symons.—Report of Committee on British rainfall.

G. J. Symons.—On the rainfall in Monmouthshire and the Severn Valley, on July 14th, and on some subsequent floods in England and Wales.

Captain H. Toynbee.—Physical Geography of the Equatorial Region of the Atlantic.

But before passing to the papers we have to consider the inaugural address of the President of the Section, Prof. Balfour Stewart; and it was so good that we are sure that in devoting to it the large space necessary for its reproduction, we are acting in the best interest of our readers :—

Since the last meeting of the British Association, science has had to mourn the loss of one of its pioneers, in the death of the veteran astronomer, Schwabe, of Dessau, at a good old age, not before he had faithfully and honourably finished his work. In truth this work was of such a nature that the worker could not be expected long to survive its completion.

It is now nearly fifty years since he first began to produce daily sketches of the spots that appeared upon the sun's surface. Every day on which the sun was visible (and such days are more frequent in Germany than in this country), with hardly any intermission for forty years, this laborious and venerable observer made his sketch of the solar disc. At length this unexampled perseverance met with its reward in the discovery of the periodicity of sun-spots, a phenomenon which very speedily attracted the attention of the scientific world.

It is not easy to over-rate the importance of the step gained when a periodicity was found to rule these solar outbreaks. *A priori* we should not have expected such a phenomenon. If the old astronomers were perplexed by the discovery of sun-spots, their successors must have been equally perplexed when they ascertained their periodicity. For while all are ready to acknowledge periodicity as one of the natural conditions of terrestrial phenomena, yet everyone is inclined to ask what there can be to cause it in the behaviour of the sun himself. Manifestly it can only have two possible causes. It must either be the outcome of some strangely hidden periodical cause residing in the sun himself, or must be produced by external bodies, such as planets, acting somehow in their varied positions on the atmosphere of the sun. But whether the cause be an internal or external one– in either case we are completely ignorant of its nature.

We can easily enough imagine a cause operating from the sun himself and his relations with a surrounding medium to produce great disturbances on his surface, but we cannot easily imagine why disturbances so caused should have a periodicity.

On the other hand we can easily enough attach periodicity to any effect caused by the planets, but we cannot well see why bodies comparatively so insignificant should contribute to such very violent outbreaks as we now know sun-spots to be.

If we look within we are at a loss to account for the periodicity of solar disturbances, and if we look without we are equally at a loss to account for their magnitude. But since that within the sun is hidden from our view, it cannot surely be considered blameworthy if astronomers have directed their attention to that without, and have endeavoured to connect the behaviour of sun-spots with the positions of the various planets. Stimulated no doubt by the success which had attended the labours of Schwabe, an English astronomer was the next to enter the field of solar research.

The aim of Mr. Carrington was, however, rather to obtain very accurate records of the positions, the sizes, and the shapes of the various sun-spots than to make a very extensive and long-continued series of observations. He was aware that a series at once very accurate and very extended is beyond the power of a private individual, and can only be undertaken by an established institution. Nevertheless, each sun-spot that made its appearance during the seven years extending from the beginning of 1854 to the end of 1860 was sketched by Mr. Carrington with the greatest possible accuracy, and had also its heliographic position, that is to say its solar latitude and longitude, accurately determined.

One of the most prominent results of Mr. Carrington's labours was the discovery of the fact that sun-spots appear to have a proper motion of their own—those nearer the solar equator moving faster than those more remote. Another was the discovery of changes, apparently periodical, affecting the disposition of spots in solar latitude. It was already known that sun-spots confined themselves to the sun's equatorial regions, but Mr. Carrington showed that the region affected was liable to periodical elongations and contractions, although his observations were not sufficiently extended to determine the exact length of this period.

Before Mr. Carrington had completed his seven years' labours, celestial photography had been introduced by Mr. Warren De la Rue. Commencing with his private observatory, he next persuaded the Kew Committee of the British Association to allow the systematic photography of the sun to be carried on at their observatory under his superintendence, and in the year 1862 the first of a ten years' series of solar photographs was begun. Before this date, however, Mr. De la Rue had ascertained, by means of his photoheliograph, on the occasion of the total eclipse of 1860, that the red prominences surrounding the eclipsed sun belong, without doubt, to our luminary himself.

(To be continued.)

REDUCTION OF BAROMETER READINGS TO SEA LEVEL.

To the Editor of the Meteorological Magazine.

SIR,—With respect to barometric reductions to sea level, "J. G. H.," in the July magazine, does not, I think, quite solve the matter. There are several tables derived from formulæ (by Laplace, Bessel and others) for computing with accuracy barometrical heights; but they do not agree, because different numerical values are used in their construction. Guyot employs Laplace's formula, co-efficient of expansion ·00260, and makes ·4 of an inch at a pressure of 30 in. correspond to 346 feet; whilst Delcros, employing the same formula but different co-efficient ·00283, makes that elevation at the same pressure equal 353 feet (*vide* Smithsonian Meteorological Tables). Plantamour employs Bessel's formula, and co-efficient ·00204; Baily, ·00222.

These tables being computed by formulæ worked out with different

constants, necessarily disagree as much as the ordinary tables that are published (*vide* Buchan, Drew and Scott). I think meteorologists should come to some understanding as to what tables should be employed.—Yours faithfully,

KAUFMANN J. MARKS.

14, *Warrington Crescent, Maida Hill, W.*

[We have received from a competent writer some memoranda upon this subject, but in so rough a form that he does not wish his name attached to, or to be held responsible for, them. As we think that they are far too good for the waste basket we print them just as they are, with these few words of prefatory explanation.]

The letter of "J. G. H." in July number appears to be altogether founded on a misapprehension—

(1). The correction deduced from Sir Geo. Shuckburgh's formula is *not* intended to apply to mean height of barometer, and *does* take into account the variation due to variation of height of barometer at place of observation.

(2). The methods of correction ordinarily used for reducing barometrical observations to sea level *are* derived from the formula for determining heights by the barometer.

(3). The Tables for correction in ordinary use are more convenient for the purpose than the method suggested by "J. G. H."

(4). No reliable rule can be given for the variation of temperature with the height, and even if it could it would not generally be worth while using, as the correction due to this would be so slight. Taking a station 600 feet above sea level, and assuming the temperature at it to be 50°, and at sea level 52°,* the correction due to taking the true mean temp. 51° instead of the temp. at upper station 50°, would only be ·001 inch.

Mr. Kaufmann Marks' letter, in May number, is much more to the purpose. The differences in the tables of correction arise (1) from the formulæ used, (2) from the constants employed in the formulæ.

(1). Sir Geo. Shuckburgh's formula is now generally acknowledged to be incorrect, and that of Laplace is adopted in lieu of it. "Scott's Instructions" are founded on Laplace's formula.

(2). The constants employed in Laplace's formula vary, and the "height of a column of air which will cause a rise of 1 inch of mercury at a temperature of 32°," or in other words, the relative weights of air and mercury is one of these constants. Scott adopts Laplace's original constants, but these have been modified by Plantamour and other recent authorities.

Mr. Kaufmann Marks makes an error in his postscript. ·004 is Laplace's co-efficient of expansion of moist air for centrigade degrees; ·002036 Regnault's co-efficient of expansion of dry air for *Fahrenheit* degrees, and therefore not comparable. I have not the other books to refer to, but believe Drew and Gay-Lussac to be Fahrenheit.

* 1° in 300 feet.

THUNDERSTORM OF AUGUST 3RD.

To the Editor of the Meteorological Magazine.

SIR,—On the morning of Tuesday last, the 3rd of this month, a violent thunderstorm burst over this chapelry and portions of the adjoining parishes. About 10.35 distant thunder was heard in the south west, which became more frequent and approached rapidly. At 11.15 a deluge of great rain fell for three or four minutes, followed by a fall of large hailstones, from the size of peas to that of small marbles. This continued for four or five minutes more, till the ground was nearly covered. A violent rain then set in, which continued nearly an hour, accompanied by frequent brilliant lightning, terrific peals of thunder, and great darkness. The storm then passed off to the north, and a steady rain fell for an hour longer.

During the continuance of the storm, the fall of rain and hail amounted to 1·71 in. in depth, of which about 1·50 in. fell during the first hour. When the rain gauges were examined after the storm, the water was found to be opaque, and of a bluish-black colour, but appeared to contain no sediment. The same was the case with all the soft-water tanks in the district, even those supplied from slated roofs, where there could be no chance of contamination from extraneous matter. The storm appears to have been confined to a small locality, for at the distance of a few miles to the east and west, there was no violent rain. No damage was done by the lightning or the hail, but the fields and roads were greatly washed by the rain.

I am, dear Sir, yours truly,

THOS. HENRY DAVIS.

Orleton, Tenbury, August 7th, 1875.

THUNDERSTORMS OF AUGUST 7TH.

THERE were several detached storms on this day, and at present we are unable to define their areas precisely. Even in the immediate vicinity of the Metropolis our information is insufficient to prove whether there was or was not any connection between the Enfield and Blackheath storms. It will be convenient to give the totals which have at present reached us :—

Camden Square	0·45 in.	Bickley	1·70 in.
Muswell Hill	0·43	Chislehurst	1·40
Pinner Hill	0·00	Beckenham Hall	1·75
Enfield	2·75	,, Foxgrove	1·69
Riverhead	0·12	Forest Hill	1·48
Bromley Common	1·25	Greenwich	1·24

To the Editor of the Meteorological Magazine.

SIR,—One of the most awful thunderstorms that has visited this neighbourhood for many years occurred here to-day. Thunder was first heard in S. soon after 1 p.m. The storm approached slowly from S., and from 1·45 to 3.30 p.m. the lightning and thunder were terrific, the storm most of the time being overhead. A tremendous fall of hail

and rain commenced at 2.5 and ceased at 3, during which time no less than 2·75 in. fell—the largest fall I have ever registered. Incessant thunder continued in S. and S.E. till 5 p.m., when the clouds rapidly dispersed. Frequent lightning after dark.

The rain caused great damage, the roads at places being almost destroyed and the town completely inundated, the water in some streets being 3 to 4 feet deep.—Yours truly,

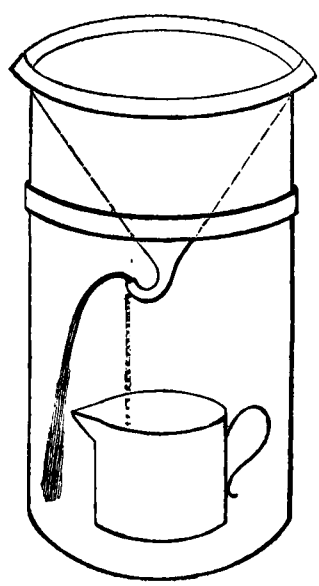
THOS. PAULIN.

P.S.—Since writing the above, I find the damage done by the flood has been very serious. At Mr. Twells' a large tree was struck, and sixty feet of brick wall carried away by the water. The water was 4 to 6 feet deep in many houses, and walls have been carried away in several places, in one place 30 yards of brick wall 12 feet high.

Enfield, 7th August, 1875.

To the Editor of the Meteorological Magazine.

Sir,—I want to draw your attention to what appears to me to be a defect in Glaisher's Rain-gauge. I have not noticed it before, but I never remember having such rain as we had here on the 7th. On examining the gauge I found not above half-an-inch in the cup, but a quantity in the bottom of the cylinder, nearly an inch. I confess I was puzzled; but after trying several ways of solving the difficulty, I did so. When the rain is so tremendous the funnel becomes full, the small tube not being sufficiently large to carry it off by a gentle stream into the cup, consequently the pressure forces it in a stream over the edge of the cup in the direction shewn in the sketch. True, the cylinder receives it, but it is most desirable that all the rain, under any extraordinary circumstances, should fall into the cup, and I think it might be easily remedied by the bore of the funnel being enlarged. Another objection to the small aperture in the funnel is the danger (in such rain as we then had) of the funnel being choked by grit from splashing, as mine was for a time. Perhaps this is worth your notice.



Yours truly,

A. RAWSON.

The Vicarage, Bromley Common, Kent, Sept., 1st, 1875.

To the Editor of the Meteorological Magazine.

Sir,—Yesterday, August 7th, after the warmest night this year (min. 59°·9) and a hot, calm morning, a storm of an almost tropical

character, accompanied by a squall which did considerable damage to the trees, suddenly broke over Beckenham.

Violent thunder and lightning, with a deluge of rain and hail began at 1.54 p.m., and in a few minutes the roads were converted into rivers, and all low-lying parts flooded from 6 inches to a foot deep. By 2.24 p.m. 1·440 in. of rain had fallen, considerably more than an inch of it in the first ten minutes. The thunder and lightning continued till past 5 p.m., and heavy showers at about half-past 2 and a quarter to 5 p.m. increased the total rainfall during the storm to 1·686 in., or ·253 in. more than fell during the 24 hours' incessant downpour between 9 a.m. on the 15th and 9 a.m. on the 16th of July. With the exception of a few minutes during the storm, the day was calm and the barometer was steady.—Yours truly,

PERCY BICKNELL.

Foxgrove, Beckenham, 8th August, 1875.

To the Editor of the Meteorological Magazine.

SIR,—There was a terrific thunderstorm here on 7th ult., and as the rainfall was so large for that day I send you note of the total amount, viz., 1·745 in. I am told that "nearly the whole of it fell between 3 and 4 p.m.; it began with large hailstones, and then sheets of water straight down," and that it came from N.E. Also that there was no rain at West Wickham, three miles south of here, nor any at Croydon, and much less at Penge than here; at Blackheath it was tremendous.—Yours very truly,

C. O. F. CATOR.

Beckenham, 1st Sept., 1875.

To the Editor of the Meteorological Magazine.

SIR,—It may interest you to know that the quantity of rain which fell here on Saturday afternoon was 1·40 of an inch. I am informed that at Bickley, about half-a-mile from here, the fall was 1·70 in.

Yours faithfully,

HUGH A. SILVER.

Hillside, Chislehurst, August 9th, 1875.

To the Editor of the Meteorological Magazine.

SIR,—On Friday, the 6th inst., we had a heavy shower from 3.58 to 4.3 p.m., in which ·08 in. of rain fell, accompanied with thunder; it came from E.N.E.

On Saturday, the 7th, we had a severe thunderstorm from 1.45 to 2.45 p.m.; the rain was tremendous, flooding the roads and gardens more than I have ever observed here before. It passed over us from S.E. to N.W., and thunder was heard from distant storms in S.E.–N. till 5.5 p.m.

The wind was N.E. at 9 a.m.; E. at noon, 1.35, and 2.35 (strong); S. at 1.15; S.S.E. at 2; S.W. at 2.10; S.S.E. at 2.20; S.E. at 5;

E.S.E. at 7; S.W. at 8; S.E. at 9; and W. at 11.30 p.m.; generally calm afternoon, and atmosphere oppressive. Shade temp.: max. 83°·8, min. 60°. Thunder first heard in S.E. at 1.33 p.m., was frequent and loud, with vivid lightning, quarter to half-a-mile distant, 2.3 to 2.28 p.m.; lightning again in S.E. at 4.30 p.m.; there was a slight shower from 5.10 to 5.20.

Rain fell 1.45–2.45 p.m., heavily 1.55–2.40, and 2.41–2.42; very heavily 2.2–2.12; 2.14–2.24, at times to 2.32, and again at 2.39 p.m. No rainfall before 1.45; 0·07 in. by 2; 0·25 in. by 2.7; 0·36 in. by 2.9; 1·28 in. by 2.35; 1·37 in. by 2.37; 1·44 in. by 2.40; 1·48 in. by 2.45 (no measurable amount fell till 9 a.m. on 8th); this is the max. daily fall yet registered here. The heaviest rates were: 0·11 in. 2.7–2.9 (2 min.) [=3·30]; 1·12 in. 2.7–2.37 (30 min.) [=2·24]; 1·37 in. 2.0–2.40 (40 min.) [=2·06]; and the total 1·48 in. 1.45–2.45 (one hour).

Yours very truly,

E. E. GLYDE.

3, *Church Road, Forest Hill, S.E., Aug. 9th*, 1875.

To the Editor of the Meteorological Magazine.

SIR,—A violent thunderstorm, accompanied by a deluge of rain, burst over this town yesterday at noon. Rain had been falling steadily but in small quantities from 9 in the morning. At noon, the clouds seemed as if massed together, and from that hour till 2 p.m. there was an almost incessant downpour, the rainfall at 2 p.m. being 1·89 inches; the afternoon was comparatively fine, but at 7 p.m. rain again came on, sometimes heavily, but nothing comparable to the fall at noon. The total rainfall during the 24 hours was 2·21 inches, greater than any registered within the last five years.

I am, yours faithfully,

RICHARD TYRER.

Grove House, Mansfield, August 8th, 1875.

AUGUST METEORS.

To the Editor of the Meteorological Magazine.

SIR,—A look-out was kept up for the Perseides from 10 p.m. last night, August 10th, to 1.30 a.m. this morning, August 11th; but notwithstanding the fineness of the night, not more than from 90 to 100 meteors were observed during the whole of that time. Of these about a dozen were equal to stars of first magnitude, and accompanied by trains; the rest from second to fourth magnitude, a few exceedingly minute ones not being counted. Two observers were looking out, but the attention of both was generally directed to the same portion of the heavens, viz., the S.E. hemisphere from 10 p.m. to about midnight, and N.W. hemisphere from about midnight to 1.30 a.m. The sky was brilliantly clear, excepting a cloudy period from 10.20 to 10.50 p.m.

G. T. RYVES.

Tean Vicarage, near Cheadle, Staff., Aug. 11, 1875.

DETAILS OF A FLASH OF LIGHTNING.

To the Editor of the Meteorological Magazine.

SIR,—As I think you collect statistics of damage done by lightning, you may like to know that during the tremendous storm which prevailed here, between 4.30 and 5.30 p.m., on Thursday, August 12th, a house was struck at Lower Tean, a hamlet about half-a-mile to the south of Upper Tean, and the chimney completely demolished, but no further injury done of a serious character, though the escape of the inmates of the house was, under the circumstances, little short of miraculous. I inspected the house, or rather houses, for there were three all in one block, more or less touched; but a full report would take too much time. I may, however, say that, after smashing the chimney-stack, the *debris* of which was not hurled in one direction but scattered to every quarter of the compass, as if by an explosion from within, the main weight of the discharge—or, at any rate, a portion of it—forced its way through the outer wall, leaving a rift about a foot long and perhaps an inch wide, and glanced on to a spouting which it followed along the fronts of the three houses and round to the back of the third (*i.e.*, the farthest from the one first struck), where it found its way down by an escape-pipe to the water-butt, which it slightly chipped in two places, leaving no further trace of its course. In passing along the fronts of the three houses it melted some of the lead in a lattice window which stood open in the first house, also a small portion of the spouting; knocked down a child who was standing at the open door of No. 2, burning two of his fingers, and broke a tile and partly dislodged a few bricks in passing from No. 2 to No. 3. It also melted a part of the pipe by which it descended to the water-butt.

The remainder of the discharge seems to have found its way down the chimney into the room beneath and out at the open door. A child, who was sitting near the door with his back against a little closet, on the opposite side of the room to the fire-place, declared that it saw a ball of fire come down the chimney and pass out at the door. And that part of the flash must have gone that way is proved by the fact that the child's hair was singed, and that the outside surface of a board forming part of the closet, against which he was sitting, was completely blistered. Finally, a man who was breaking coal in the yard outside the door in question, declared that the flash passed through his legs! and, improbable as this sounds, yet, if for *the flash* we read *part of the flash*, his story may after all be true, as, in breaking coal with his back to this door, which I ascertained to be the case, the pick or coal hammer would have been in such a position as to attract that part of the electric discharge which passed out at the door.

All these facts and impressions I had from the occupier of the house which was struck and his neighbours on the spot, so that they have at any rate the advantage attaching to evidence obtained at first hand.

Yours faithfully,

GEORGE T. RYVES.

Tean Vicarage, Stoke-on-Trent, Aug. 19th, 1875.

RAINFALL AND YIELD OF WELLS.

To the Editor of the Meteorological Magazine.

SIR,—In the December number of the *Meteorological Magazine* you inserted a letter of mine on the above subject. The January rainfall of this year here, 4·10 in., of which nearly 2·00 in. fell between the 20th and 26th of that month, raised the well on which I rely 2 ft. 6 in., making a total with the autumn rise of 5 ft. 6 in.—a fair average stock of water to be given out during the remainder of the year, with the addition of a small rise in February. It might be expected that the heavy July fall here, 4·45 in., of which 3·21 in. fell between the 15th and 22nd, inclusive, would have raised the subterranean stock of water considerably, whereas the water in the well only rose 1½ inches, confirming the assertion of my letter, October 31st, 1874: That it is rather the conditions under which the rain falls than the quantity falling which rules the subterranean supply. The large amount of July rain did little more than replace the evaporation and that absorbed by vegetation. The surface wells, gravel on clay, were raised about 6 inches, as might be expected.

I am, Sir, yours faithfully,

J. C. CLUTTERBUCK.

Long Wittenham, August 9th, 1875.

SUPPLEMENTARY TABLE OF RAINFALL IN AUGUST, 1875

[For the Counties, Divisions, Latitudes, and Longitudes of these Stations, see Met. Mag., Vol. X., p. 28.]

Station.	Total Rain.	Station.	Total Rain.
	in.		in.
Acol	1·62	Gainford	2·40
Hailsham	...	Shap	2·83
Strathfield Turgiss	1·24	Llanfrechfa	2·67
Addington Manor	1·30	Castle Malgwyn	6·01
Oxford	1·37	Heyope	3·59
Cambridge	1·05	Melrose	2·19
Sheering	1·35	Cessnock, Glasgow	2·62
Ipswich	·74	Gruinart	4·34
Diss	·73	Keith	3·02
Swaffham	·85	Strathconan	3·62
Compton Bassett	1·18	Springfield, Tain	2·14
Hessary Tor, Dartmoor	5·37	Skibbereen	2·60
Teignmouth	2·17	Fermoy	3·02
Torrington	3·34	Kilrush	1·59
Trevarrick, St. Austell	2·81	Kilkenny	2·54
Taunton	2·42	Kilsallaghan	1·87
Cheadle	2·50	Twyford, Athlone	3·17
Ashby de la Zouch	2·28	Ballinasloe	2·30
Coston, Melton Mowbray	2·79	Kylemore	5·39
Bucknall	2·01	Bangor	2·12
Mansfield	3·45	Carrick on Shannon	3·71
Walton, Liverpool	2·76	Warrenpoint	3·62
Broughton-in-Furness	4·54	Bushmills	4·17
Stanley, Wakefield	2·46		

REVIEW.

Jahrbücher der KK central-anstalt für Meteorologie und Erdmagnetismus, von Dr. Carl Jelinek, KK Hofrath u.s.w., und Prof. F. Osnaghi, Neue Folge ix. *Jahrgang*, 1872, *und Neue Folge* x. *Jahrgang*, 1873. 4to. Vienna: Braumüller, 1874 and 1875.

WE are sorry to see that Dr. Jelinek has not yet reduced his staff to anything like uniformity of procedure, although it was better in 1873 than in 1872, and we, therefore, hope that it will steadily improve. Nearly all his observers take readings three times daily, and of the total number (138) nearly half of them observe at 7 a.m., 2 p.m. and 9 p.m.; another body, of about thirty, observe at 6, 2 and 10; while the rest of the corps indulge in an almost endless variety of combinations, in fact there were 24 varieties in 1872, and 19 in 1873. As some of these combinations give very different mean values from others, it is most desirable that some one system should be adopted, and that all observations not made in accordance therewith should either be rejected or printed separately.

There are, however, a few stations which are even worse arranged, for the observers change their hours of observation two or more times a year. They would hardly do worse if they returned to the bad old plan of taking observations at the times of sun-rise and sun-set.

We hope that Dr. Jelinek will turn his attention to this subject, and that in succeeding years we shall see the nineteen varieties reduced to two or three, and all returns not made with absolute uniformity throughout the year, thrown into an appendix, or otherwise prevented injuring the other values.

The Appendix to the volume for 1872 contains very useful abstracts of 33 years' (1841–73) observations at Trieste, and of 46 years (1828-73) at Bodenbach, in Bohemia. The volume for 1873 has the convenient addition of a clearly printed map of the stations of which the returns are quoted in the volume.

The leading features of the Meteorological data for the two stations just mentioned are as follows:—

Station	Nautical Academy, Trieste.	Bodenbach, Bohemia.
Latitude	45° 48′ N. ...	50° 46′ N.
Longitude	13° 46′ E. ...	14° 8′ E.
Height above Sea	78 ft.	466 ft.
Period	1841–73	1828–1873.
Mean temp. in shade	57°·8	47°·5.
Highest mean, yearly temp. & date.	60°·6, 1841 ..	51°·3, 1834.
Lowest ,, ,, ,, ,,	55°·6, 1864 ...	43°·9, 1838.
Max. in shade and date	99°·5, July, 1873...	100°·6 July, 1828. Aug., 1830.
Min. ,, ,, ...	10°·6, Dec., 1855...	—29°·4, Feb., 1830.
Mean Sea Level pressure	29·961 in.... ...	30·020 in.
Max. ,, ,, ,, and date ...	30·774, Jan., 1859.	30·952, Dec., 1840.
Min. ,, ,, ,, ,, ...	28·839, Feb., 1843.	28·834, Dec., 1856.
Mean yearly rainfall	43·31 in.	24·88 in.
Greatest ,, ,, and date ...	63·15, 1855 ...	34·84, 1854.
Least ,, ,, ,, ...	26·58, 1865 ...	17·28, 1842.
Greatest rainfall in 24 hours ...	5·39, Oct., 1849 ...	1·89, July, 1860.

AUGUST, 1875.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1860–5	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Date.	Min. Deg.	Date.	No. of Nights below 32° In shade	On grass
			inches	inches.	in.								
I.	ENGLAND.	Camden Town	1·79	— ·85	·66	19	12	86·1	16	45·3	2	0	0
II.		Maidstone (Linton Park)	1·38	— 1·33	·82	29	8	87·0	16	48·0	2	0	0
,,		Selborne (The Wakes)	1·32	— 1·86	·28	10	12	78·0	14	39·0	2	0	0
III.		Hitchen	1·32	— 1·03	·67	28	11	77·0	16	41·0	1	0	...
,,		Banbury	1·12	— 1·01	·21	12	11	84·0	16	43·0	1	0	0
IV.		Bury St. Edmunds (Culford)	·88	— 1·56	·38	13	10	84·0	16	41·0	1	0	0
V.		Bridport	2·16	— ·43	·94	8	13	72·5	20	40·0	2	...	..
,,		Barnstaple	3·30	— ·89	1·00	8	16	80·0	17	48·0	5	...	...
,,		Bodmin	2·77	— 1·09	·95	11	13	74·0	16	46·0	22	0	0
VI.		Cirencester	1·21	— 1·63	·23	9	9	...	...	...	...	...	...
,,		Shifnal (Haughton Hall)	3·56	+ ·69	·87	11	18	78·0	16	43·0	21	0	0
,,		Tenbury (Orleton)	4·08	+ 1·20	1·71	3	16	80·8	16	41·0	21	0	0
VII.		Leicester (Belmont Villas)	2·57	+ ·38	·77	7	15	86·0	16	47·5	3	0	0
,,		Boston	1·91	— ·38	1·15	12	11	85·0	16	45·0	2	0	0
,,		Grimsby (Killingholme)	2·82	...	1·07	7	13	80·0	16	46·0	2	0	...
VIII.		Manchester	5·00	+ 1·50	1·58	7	19	82·0	17	41·0	5	0	0
IX.		York	2·17	— ·54	...	...	...	82·0	16	42·0	9	...	...
,,		Skipton (Arncliffe)	3·56	— 2·38	·80	9	20	75·0	1	36·0	4	...	...
X.		North Shields	3·41	+ ·56	1·00	7	16	72·3	16	42·8	5	0	0
,,		Borrowdale (Seathwaite)	7·87	— 6·27	1·74	23	16	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely)	..	...	...	...	...	...	...	...	...	...	...
,,		Haverfordwest	4·66	— ·22	1·76	10	14	73·5	8	45·0	4, 9*	...	...
,,		Rhayader (Cefnfaes)	...	...	...	...	...	...	...	..	...	...	...
,,		Llandudno	2·00	— 1·82	·39	8	13	76·2	12	47·5	20	...	...
XII.	SCOTLAND.	Dumfries (Crichton Asylum)	2·31	— 1·56	·43	3	14	70·6	16	43·2	2	...	...
,,		Hawick (Silverbut Hall)	2·38	...	·44	9	21	...	...	...	...	...	...
XIV.		Kilmarnock (Annanhill)	3·37	...	1·30	16	18	69·7	17	46·0	5	0	0
XV.		Castle Toward	4·55	— 1·75	·72	17	18	...	...	...	...	...	...
XVI.		Leven (Nookton)	1·51	— 1·48	·23	18	18	75·0	15	43·0	20	0	0
,,		Stirling (Deanston)	...	...	...	...	...	...	...	...	..	...	...
,,		Grandtully	2·89	...	·39	30	20	...	...	..	...	...	...
XVII.		Braemar	3·20	— ·64	·55	12	24	70·3	15	37·8	20	0	0
,,		Aberdeen	2·35	...	·55	22	20	73·2	17	45·9	20	0	0
XVIII		Loch Broom	3·81	...	·42	29	18	...	...	...	...	...	..
,,		Portree	8·23	+ ·78	1·73	20	18	...	...	...	...	...	...
,,		Inverness (Culloden)	2·06	— 1·19	·53	31	16	71·0	16	44·8	2	0	0
XIX.		Helmsdale	2·91	...	·47	31	17	...	...	...	...	...	...
,,		Sandwick	2·68	— 1·03	·45	29	16	68·8	5	43·2	14	0	0
XX.	IRELAND.	Caherciveen Darrynane Abbey	3·24	...	·76	23	11	...	...	...	...	...	...
,,		Cork	2·41	...	·51	31	14	...	...	...	...	...	...
,,		Waterford	2·28	— 1·67	·73	8	13	73·0	18	48·0	2,27	...	0
,,		Killaloe	3·48	— 1·45	·93	16	17	81·0	1	37·0	2	.	...
XXI.		Portarlington	1·63	— 2·87	·36	24	18	74·0	9	45·0	5	0	...
,,		Monkstown, Dublin	1·47	— 1·74	·67	9	11	...	...	...	...	...	...
XXII.		Galway	...	...	...	...	...	...	...	...	...	...	...
,,		Ballyshannon	3·60	...	·53	9	19	...	...	...	...	...	...
XXIII		Waringstown	2·63	...	·56	7	18	80·0	1, 2	41·0	4	0	0
,,		Edenfel(Omagh)	3·98	...	·72	7	18	72·0	15	38·0	6	0	0

* And 29.

+Shows that the fall was above the average; —that it was below it.

METEOROLOGICAL NOTES ON AUGUST.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

LINTON.—A very fine, useful month for the farmer, the ample R of July supplying vegetation with the necessary moisture. Fogs frequent, but very little T; a heavy but useful R, ·82 in., on the 29th, and a less plentiful one on the 22nd; otherwise the month a very dry one, with no lack of sunshine; winds mostly S. and S.W., but never high; bar. steady; on the whole a remarkably fine month.

SELBORNE.—Fog on 6th, 7th, 20th, 24th, 30th, and 31st.; T at 7 p.m. on 7th, and TS at 3 a.m. on 9th. Prevailing winds S. and S.W. at the middle of the month. R very much below the average for August; the finest crop of hops for 25 years.

BANBURY.—Fog on 3rd; TS on 3rd, 9th, and 12th; T on 6th and 7th.

CULFORD.—T on 6th and 12th. A somewhat dry and warm month, the max. temp. being in both cases considerably above that of the preceding month (July). Easterly winds only on four days.

BODMIN.—Mean. temp. 65°·3. R very much below the average.

SHIFNALL.—The R of July, after ten days' interval, returned on the night of the 5th, and continued daily till the 15th, the fall of the 11th and 12th amounting to 1·26 in. The temp. of the nights low till the 6th, T in the distance on 3rd. A violent storm from W., with pitch darkness, at 4.30 p.m. on 12th; distant T again on 19th p.m. in S.E., and violent on 28th, at 5.30 p.m. in E. Tree wasps (*V Britanica*) unusually abundant; but these, as well as the common ones, destroyed by the R. Fungi of all sorts plentiful, but not a mushroom since those in May. Nuts and all fruit plentiful, especially damsons and plums. Potatoes sadly diseased.

ORLETON.—The first half of the month was warm, damp, and cloudy, with R almost every day. The last half was fine harvest weather, warm and bright, with very little R. Soon after 11 a.m. on 3rd, a violent storm of L, T, H, and R burst over us; about 1·50 in. of R fell in less than one hour. Another TS occurred about 4 a.m. on the 9th, with heavy R; and another great fall of R occurred early on the morning of the 11th, which filled the brooks and rivers. The temp. of the month was about 1° higher than the average, and was very uniform. T was frequently heard in the distance, and L seen at night; there was no high wind.

LEICESTER.—A severe TS between 10 a.m. and noon on the 7th, and again between 6.25 and 6.50 p.m. Some houses on the Humberton Road were struck, and about £50 worth of damage done. TS also on 9th and 12th. After 14th, fine harvest weather; temp. above 80° on one day only (16th).

BOSTON.—Very heavy TS on 12th; wind from N.W.; ·60 of R fell in 25 minutes; total in the day, 1·15. Harvest begun on the 6th. New wheat brought to market on 21st, which is exactly the average time; cutting finished by the end of the month. The cold temp. and heavy R of July spoiled a most promising crop; the yield is generally estimated as 25 per cent. less than that of last year.

GRIMSBY.—Heavy hailstorm on 9th; harvest general on 11th; month fine and warm; corn crop deficient both in quantity and quality. Potatoe disease worse than for several past years; apples, plums, &c., abundant; root crops excellent. T and R between 10 a.m. and noon on 29th.

MANCHESTER.—7th, heavy T S, H and heavy R; 10th, meteors from 10 to 11 p.m.; heavy T S on 12th, and another on 13th.

ARNCLIFFE.—A beautiful month.

NORTH SHIELDS.—T on 8th, and TS with heavy R on 10th.

SEATHWAITE.—T on 7th, 9th, 10th, and 11th; L on 29th; R fell on 16 days, but the fall (7·87) was little more than half the average.

WALES.

HAVERFORDWEST.—The first five days warm and bright, then came a period of broken weather, with heavy rainfall continuing, more or less, to the 17th; high temp. day and night. The 9th stormy, sultry air, much T and L; a remarkable whirlwind, about 5 miles from Haverfordwest, on the river Cleddan; during the storm of T, L and R, a haycock was lifted some 50 feet in the air; stones and gravel were also lifted and strewn like a hail-shower over a space of a quarter-of-a-mile; the phenomena was accompanied by a loud rumbling noise like mill machinery; the L was forked and very vivid, and the rainfall great in some places; on the morning of the 10th, in little more than 4 hours 1·76 in. of R fell here, occasioning a disastrous flood, Stepaside and Egremont bridges being carried away; still, taking the whole month, harvest operations were more successful than anticipated. At 3 a.m. on 10th very dark, drizzling, but no R of consequence till 5 a.m.; air very still, then a deluge descended, producing in some districts, particularly in the mountainous parts of the country, floods of unprecedented magnitude; near Llysifran and Egremont two bridges carried away, and much hay and corn lying in the lowlands carried quite away; this R of nearly 2 inches falling in 4 hours, between 5 and 9 a.m., produced much more disaster than the great fall of July, which took 29 hours to produce 3·33 in.

LLANDUDNO.—9th, T S about 2 p.m., R in the night; 12th, T S at 1.30 p.m.; the mean temp. (though slightly below that of August, 1874) was rather more than 1° above the average. The rainfall was considerably below the average, in fact very little more than half; altogether a month of fine weather.

SCOTLAND.

DUMFRIES.—Month generally warm, without any high winds; R only one-third of the fall of August, 1874; and considerably below the average. Mean. temp. 2°·5 higher than last August; T on 9th and 12th.

HAWICK.—Heavy TS on 9th; rather unsettled from 1st to 14th; then fine to 25th.

ANNANHILL.—T on 2nd, T and heavy R on 3rd and 12th; bar. pressure about the same as last month, mean. temp. 2° above it; Ozone abundant, the mean being 5·7, the tests shewing the max. on several days under S.W. winds; prevailing winds S.W., light to moderate; month generally unsettled; skies cloudy and threatening; T and vivid L, with heavy R on the evening of the 30th; harvest operations far advanced; crops generally good; blight appeared in the potatoe on the 13th. Foot and mouth disease very virulent among the cattle, and in many cases fatal.

CASTLE TOWARD.—Harvest is now begun, much of the corn is ripe, and the remainder rapidly becoming so, all accounts agree that the corn bulks well, but early threshing will soon try the quality of the new crops. Beans still green in the stalk and looking well; turnips, large bulbs and still growing; potatoes are fading fast, and in the shaws rather prematurely; the disease has set in here but slightly as yet. Farmers digging up large portions, and forwarding them to market where they fetch fair prices. Foot and mouth disease spreading, but no cases fatal.

BRAEMAR.—Rather a dull month; crops looking well; T, 11 to 2, on 11th; T S 10 to 12 p.m. on 17th.

ABERDEEN.—T on 2nd, 8th, and 11th; and T S, 10 to 11 p.m. on 17th; Fog on 3rd, 14th, 25th and 29th. Bar. pressure and mean temp. above the average; R and wind pressure below it. A month of dull, quiet, and very mild weather, with fewer heavy rains than usual.

LOCHBROOM.—The R retards the cutting of the crops very much, indeed it is beginning to be rather serious now.

PORTREE.—A fine month on the whole; squally from 16th to 27th with frequent heavy R, upwards of 1·00 in. fell on 21st, 23rd, and 24th, total fall 8·23, making 41·64 in. since 1st of January. All kinds of crops look well; the harvest will be general here within a week. Potatoes abundant and of fine quality; turnips doing well.

SANDWICK.—A fine month, the temp. above and the rainfall considerably below the average. Harvest is begun, and crops looks well; T about 5 p.m. on 25th.

IRELAND.

DARRYNANE.—A fine harvest month, with some days of heavy R like T showers. On the 12th when there was no measurable R fell here, about 1 mile distant and 400 feet above my guage the R was very heavy, and a few miles off so much so as to flood the rivers and endanger the bridges.

MONKSTOWN.—Month unusually dry and warm, extremely favourable for farming operations.

BALLYSHANNON.—Although there were some heavy rains and high winds during the month, it was nevertheless a favourable one for ripening the harvest, and making hay. This neighbourhood is very free from the potato disease, and the principal crops are abundant.

WARINGSTOWN.—Harvest commenced generally about the 20th; weather rather stormy, but crops excellent.

EDENFEL, OMAGH.—Weather, although somewhat broken, has been for the most part very favourable. Harvest general from the 20th, with the most abundant promise within living memory.

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THE BRITISH ASSOCIATION AT BRISTOL.

CONCLUSION OF PROF. BALFOUR STEWART'S ADDRESS.

(Continued from page 119.*)*

The Kew observations are not yet finally reduced, but already several important conclusions have been obtained from them by Mr. De la Rue and the other Kew observers. In the first place the Kew photographs confirm the theory of Wilson that sun-spots are phenomena, the dark portions of which exist at a level considerably beneath the general surface of the sun; in other words, they are hollows, or pits, the interior of which is of course filled up with the solar atmosphere. The Kew observers were likewise led to associate the low temperature of the bottom of sun-spots with the downward carriage of colder matter from the atmosphere of the sun, while the upward rush of heated matter was supposed to account for the faculæ or bright patches which almost invariably accompany spots. In the next place the Kew observers, making use not only of the Kew series but of those of Schwabe and Carrington, which were generously placed at their disposal, have discovered traces of the influence of the nearer planets upon the behaviour of sun-spots. This influence appears to be of such a nature that spots attain their maximum size when carried by rotation into positions as far as possible remote from the influencing planet—that is to say into positions where the body of the sun is between them and the planet. There is also evidence of an excess of solar action when two influential planets come near together. But although considerable light has thus been thrown on the periodicity of sun-spots, it ought to be borne in mind that the cause of the remarkable period of eleven years and a quarter, originally discovered by Schwabe, has not yet been properly explained. The Kew observers have likewise discovered traces of a peculiar oscillation of spots between the two hemispheres of the sun, and finally their researches will place at the command of the observers the data for ascertaining whether centres of greater and lesser solar activity are connected with certain heliocentric positions.

While the sun's surface was thus being examined both telescopically and photographically, the spectroscope came to be employed as an instrument of research. It had already been surmised by Prof. Stokes, that the vapour of sodium at a comparatively low temperature, forms one of the constituents of the solar atmosphere, inasmuch as the dark line D in the spectrum of the sun coincides in position with the bright line given out by incandescent sodium vapour.

This method of research was greatly extended by Kirchhoff, who soon found that many of the dark lines in the solar spectrum were coincident with the bright lines of sundry incandescent metallic vapours, and a good beginning was thus made towards ascertaining the chemical constitution of the sun.

The new method soon brought forth further fruit when applied in the hands of Huggins, Miller, Secchi, and others, to the more distant heavenly bodies. It was speedily found that the fixed stars had constitutions very similar to that of the sun. But a peculiar and unexpected success was attained when some of the nebulæ were examined spectroscopically. To-day it seems (so rapidly has knowledge progressed) very much like recalling an old superstition to remind you that

until the advent of the spectroscope the irresolvable nebulæ were considered to be gigantic and remote clusters of stars, the individual members of which were too distant to be separated from each other even with a telescope like that of Lord Rosse. But Mr. Huggins, by means of the spectroscope, soon found that this was not the case, and that most of the nebulæ which had defied the telescope gave indications of incandescent hydrogen gas. It was also found by this observer that the proper motions of some of the fixed stars in a direction to or from the earth might be detected by means of the displacement of their spectral lines, a method of research which was first enunciated by Fizeau. Hitherto in such applications of the spectroscope, the body to be examined was viewed as a whole. It had not yet been attempted to localise the use of this instrument so as to examine particular districts of the sun, as for instance a sun-spot, or the red flames already proved by De La Rue to belong to our luminary. This application was first made by Mr. Lockyer, who in the year 1865 examined a sun-spot spectroscopically and remarked the greater thickness of the lines in the spectrum of the darker portion of the spot.

Dr. Frankland had previously found that thick spectral lines correspond to great pressure, and hence the inference from the greater thickness of lines in the umbra of a spot is, that this umbra or dark portion is subject to a greater pressure; that is to say, it exists below a greater depth of the solar atmosphere than the general surface of the sun. Thus the results derived from the Kew photoheliograph and those derived from the spectroscope were found to confirm each other. Mr. Lockyer next caused a powerful instrument to be constructed for the purpose of viewing spectroscopically the red flames round the sun's border, in the hope that if they consisted of ignited gas the spectroscope would disperse, and thus dilute and destroy the glare which prevents them from being seen on ordinary occasions.

Before this instrument was quite ready, these flames had been analysed spectroscopically by Capt. Herschell, M. Janssen, and others, on the occasion of a total eclipse occurring in India, and they were found to consist of incandescent gas, most probably hydrogen. But the latter of these observers (M. Janssen) made the important observation that the bright lines in the spectrum of these flames remained visible even after the sun had reappeared, from which he argued that a solar eclipse is not necessary for the examination of this region.

Before information of the discovery made by Janssen had reached this country, the instrument of Mr. Lockyer had been completed, and he also found that by its means he was able to analyse at leisure the composition of the red flames without the necessity of a total eclipse. An atmosphere of incandescent hydrogen was found to surround our luminary into which, during the greater solar storms, sundry metallic vapours were injected, sodium, magnesium, and iron forming the three that most frequently made their appearance.

Here we come to an interesting chemical question.

It had been remarked by Maxwell and by Pierce as the result of the molecular theory of gases that the final distribution of any number of kinds of gas in a vertical direction under gravity is such that the density of each gas at a given height is the same as if all the other gases had been removed, leaving it alone. In our own atmosphere the continual disturbances prevent this arrangement from taking place, but in the sun's enormously extended atmosphere (if indeed our luminary be not nearly all gaseous) it appears to hold, inasmuch as the upper portion of this atmosphere, dealing with known elements, apparently consists entirely of hydrogen. Various other vapours are, however, as we have seen, injected from below the photosphere into the solar atmosphere on the occasion of great disturbances, and Mr. Lockyer has asked the question, whether we have not here a true indication of the relative densities of these various vapours derived from the relative heights to which they are injected on such occasions

This question has been asked, but it has not yet received a definite solution, for chemists tell us that the vapour densities of some of the gases injected into the sun's atmosphere on the occasion of disturbances are, as far as they know from terrestrial observations, different from those which would be indicated by taking the relative heights attained in the atmosphere of the sun. Mr. Lockyer

has attempted to bring this question a step nearer to its solution by showing that the vapours at the temperatures at which their vapour densities have been experimentally determined are not of similar molecular constitution, whereas in the sun we get an indication, from the fact that all the elements give us line spectra, that they are in similar molecular states.

Without, however, attempting to settle this question, I may remark that we have here an interesting example of how two branches of science—physics and chemistry—meet together in solar research.

It had already been observed by Kirchhoff that sometimes one or more of the spectral lines of an elementary vapour appeared to be reversed in the solar spectrum, while the other lines did not experience reversal. Mr. Lockyer succeeded in obtaining an explanation of this phenomenon. This explanation was found by means of the method of localization already mentioned.

Hitherto, when taking the spectrum of the electric spark between the two metallic poles of a coil, the arrangements were such as to give an average spectrum of the metal of these poles; but it was found that when the method of localisation was employed, different portions of the spark gave a different number of lines, the regions near the terminals being rich in lines, while the midway regions give comparatively few.

If we imagine that in the midway regions the metallic vapour given off by the spark is in a rarer state than that near the poles, we are thus led to regard the short lines which cling to the poles as those which require a greater density or nearness of the vapour particles before they make their appearance; while on the other hand, those which extend all the way between the two poles come to be regarded as those which will continue to make their appearance in vapour of great tenuity.

Now it was remarked that these long lines were the very lines which were reversed in the atmosphere of the sun. Hence when we observe a single coincidence between a dark solar line and the bright line of any metal, we are further led to enquire whether this bright line is one of the long lines which will continue to exist all the way between two terminals of that metal when the spark passes.

If this be the case, then we may argue with much probability that the metal in question really occurs in the solar atmosphere; but if, on the other hand, the coincidence is merely between a solar dark line and a short bright one, then we are led to imagine that it is not a true coincidence, but something which will probably disappear on further examination. This method has already afforded us a means of determining the relative amount of the various metallic vapours in the sun's atmosphere. Thus, in some instances, all lines are reversed, whereas in others the reversal extends only to a few of the longer lines.

Several new metals have thus been added to the list of those previously detected in the solar atmosphere, and it is now certain that the vapours of hydrogen, potassium, sodium, rubidium, barium, strontium, calcium, magnesium, aluminium, iron, manganese, chromium, cobalt, nickel, titanium, lead, copper, cadmium, zinc, uranium, cerium, vanadium, and palladium occur in our luminary.

I have spoken hitherto only of telescopic spectroscopy; but photography has been found capable of performing the same good service towards the compound instrument consisting of the telescope and its attached spectroscope, which it had previously been known to perform towards the telescope alone. It is of no less importance to secure a permanent record of spectral pecularities than it is to secure a permanent record of telescopic appearances. This application of photography to spectrum observations was first commenced on a sufficient scale by Mr. Rutherford, of New York, and already promises to be one of the most valuable aids in solar inquiry.

In connection with the spectroscope, I ought here to mention the names of Respighi, and Secchi, who have done much in the examination of the solar surface from day to day. It is of great importance to the advancement of our knowledge, that two such competent observers are stationed in a country where the climate is so favourable to continued observation.

The examination of the sun's surface by the spectroscope suggests many interesting questions connected with other branches of science. One of these has already

been alluded to. I may mention two others put by Mr. Lockyer, premising, however, that at present we are hardly in a position to reply to them. It has been asked whether the very high temperatures of the sun and of some of the stars may not be sufficient to produce the disassociation of those molecular structures which cannot be disassociated by any terrestrial means; in other words, the question has been raised, whether our so-called elements are really elementary bodies.

A third question is of geological interest. It has been asked whether a study of the solar atmosphere may not throw some light upon the peculiar constitution of the upper strata of the earth's surface, which are known to be of less density than the average interior of our planet.

If we have learned to be independent of total eclipses as far as the lower portions of the solar atmosphere are concerned, it must be confessed that as yet the upper portions—the outworks of the sun—can only be successfully approached on these rare and precious occasions. Thanks to the various Government expeditions despatched by Great Britain, by the United States, and by several Continental nations—thanks also to the exertions of Lord Lindsay and other astronomers—we are in the possession of definite information regarding the solar corona.

In the first place, we are now absolutely certain that a large part of this appendage unmistakably belongs to our luminary, and in the next place, we know that it consists, in part at least, of an ignited gas giving a peculiar spectrum, which we have not yet been able to identify with that of any known element. The temptation is great to associate this spectrum with the presence of something lighter than hydrogen, of the nature of which we are yet totally ignorant.

A peculiar physical structure of the corona has likewise been suspected. On the whole, we may say that this is the least known, while it is perhaps the most interesting, region of solar research; most assuredly it is well worthy of further investigation.

If we now turn our attention to matters nearer home, we find that there is a difficulty in grasping the facts of terrestrial meteorology no less formidable than that which assails us when we investigate solar outbreaks. The latter perplex us because the sun is so far away, and because also his conditions are so different from those with which we are here familiar; while on the other hand, the former perplex us because we are so intimately mixed up with them in our daily lives and actions; because, in fact, the scale is so large and we are so near. The result has been that until quite recently our meteorological operations have been conducted by a band of isolated volunteers individually capable and skilful, but from their very isolation incapable of combining together with advantage to prosecute a scientific campaign. Of late, however, we have begun to perceive that if we are to make any advance in this very interesting and practical subject, a different method must be pursued, and we have only reaped the first fruits of a more enlightened policy; already we have gained some knowledge of the constitution and habits of our atmosphere.

The researches of Wells and Tyndall have thrown much light upon the cause of dew. Humboldt, Dové, Buys Ballot, Jelinek, Quetelet, Hansteen, Kupffer, Forbes, Welsh, Glaisher, and others have done much to give us an accurate knowledge of the distribution of terrestrial temperature. Great attention has likewise been given to the rainfall of Great Britain and Ireland, chiefly through the exertions of one individual, Mr. G. J. Symons.

To Dové we are indebted for the law of rotation of the wind, to Redfield for the spiral theory of cyclones, to Francis Galton for the theory of anti-cyclones, to Buchan for an investigation into the disposition of atmospheric pressure which precedes peculiar types of weather, to Stephenson for the conception of barometric gradients, to Scott and Meldrum for an acquaintance with the disposition of winds which frequently precedes violent outbreaks; and to come to the practical application of laws, we are much indebted to the late Admiral Fitzroy and the system which he greatly helped to establish for our telegraphic warnings of coming storms.

Again, the meteorology of the ocean has not been forgotten. The well-known name of Maury will occur to everyone as that of a pioneer in this branch of inquiry. Fitzroy, Leverrier, Meldrum, Toynbee, and others have likewise done

much ; and it is understood that the meteorological offices of this and other maritime countries are now busily engaged upon this important and practical subject. Finally, the movements of the ocean and the temperatures of the oceanic depths have recently been examined with very great success in vessels despatched by her Majesty's Government ; and Dr. Carpenter has by this means been able to throw great light upon the convection currents exhibited by that vast body of water which girdles our globe.

It would be out of place to enter here more minutely into this large subject, and already it may be asked what connection has all this with that part of the address that went before it.

There are, however, strong grounds for supposing that the meteorology of the sun and that of the earth, are intimately connected together. Mr. Broun has shown the existence of a meteorological period connected apparently with the sun's rotation ; five successive years' observations of the barometer at Singapore all giving the period 25·74 days. Mr. Baxendell, of Manchester, was, I believe, the first to show that the convection currents of the earth appear to be connected somehow with the state of the sun's surface as regards spots ; and still more recently, Mr. Meldrum, of the Mauritius Observatory, has shown by a laborious compilation of ships' logs and by utilizing the meteorological records of the island, that the cyclones in the Indian Ocean are most frequent in years when there are most sunspots. He likewise affords us grounds for supposing that the rainfall, at least in the tropics, is greatest in years of maximum solar disturbance.

Mr. Poey has found a similar connection in the case of the West Indian hurricanes ; and finally, Piazzi Smyth, Stone, Köppen, and still more recently Blandford, have been able to bring to light a cycle of terrestrial temperature having apparent reference to the condition of the sun.

Thus, we have strong matter-of-fact grounds for presuming a connection between the meteorology of our luminary and that of our planet, even although we are in complete ignorance as to the exact nature of this bond.

If we now turn to terrestrial magnetism the same connection becomes apparent.

Sir Edward Sabine was the first to show that the disturbances of the magetism of the earth are most violent during years of maximum sun-spots. Mr. Broun has shown that there is likewise a reference in magnetic phenomena to the period of the sun's rotation about his axis, an observation recently confirmed by Hornstein ; and still more recently, Mr. Broun has shown that the moon has an action upon the earth's magnetism which is not altogether of a tidal nature, but depends, in part, at least, upon the relative position of the sun and moon.

I must trust to your forbearance if I now venture to bring forward considerations of a somewhat speculative nature.

We are all familiar with the generalisation of Hadley, that is to say, we know there are under-currents sweeping along the surface of the earth from the poles to the equator, and upper-currents sweeping back from the equator to the poles. We are likewise aware that these currents are caused by the unequal temperature of the earth ; they are in truth convection-currents, and their course is determined by the positions of the hottest and coldest parts of the earth's surface. We may expect them, therefore, to have a reference not so much to the geographical equator and poles, as to the hottest and coldest regions. In fact, we know that the equatorial regions into which the trade winds rush, and from which the anti-trades take their origin, have a certain annual oscillation depending upon the position of the sun, or in other words upon the season of the year. We may likewise imagine that the region into which the upper currents pour themselves is not the geographical pole, but the pole of greatest cold.

In the next place we may imagine that these currents, as far as regards a particular place, have a daily oscillation. This has, I believe, been proved as regards the lower currents or trade-winds, which are more powerful during the day than during the night, and we may therefore expect it to hold good with regard to the upper-currents or anti-trades ; in fact, we cannot go wrong in supposing that they also, as regards any particular place, exhibit a daily variation in the intensity with which they blow.

Again, we are aware that the earth is a magnet. Let us not now concern ourselves about the origin of its magnetism, but rather let us take it as it is. We must next bear in mind that rarefied air is a good conductor of electricity; indeed, according to recent experiments, an extremely good conductor. The return trades that pass from the hotter equatorial regions to the poles of cold, consisting of moist rarefied air, are therefore to be regarded in the light of good conductors crossing lines of magnetic force; we may therefore expect them to be the vehicle of electric currents. Such electric currents will of course re-act on the magnetism of the earth. Now, since the velocity of these upper currents has a daily variation, their influence as exhibited at any place upon the magnetism of the earth, may be expected to have a daily variation also.

The question thus arises, Have we possibly here a cause which may account for the well-known daily magnetic variation? Are the peculiarities of this variation such as to correspond to those which might be expected to belong to such electric currents? I think it may be said that as far as we can judge, there is a likeness of this kind between the peculiarities of these two things, but a more prolonged scrutiny will of course be essential before we can be absolutely certain that such currents are fitted to produce the daily variation of the earth's magnetism.

Besides the daily and yearly periodic changes in these upper convection currents, we should also expect occasional and abrupt changes forming the counterparts of those disturbances in the lower strata with which we are familiar. And these may be expected in like manner to produce non-periodic occasional disturbances of the magnetism of the earth. Now it is well known that such disturbances do occur, and further that they are most frequent in those years when cyclones are most frequent, that is to say in years of maximum sunspots. In one word, it appears to be a tenable hypothesis to attribute at least the most prominent magnetic changes to atmospheric motions taking place in the upper regions of the atmosphere where each moving stratum of air becomes a conductor moving across lines of magnetic force; and it was Sir Wm. Thompson, I believe, who first suggested that the motion of conductors across the lines of the earth's magnetic force must be taken into account in any attempted explanation of terrestrial magnetism.

It thus seems possible that the excessive magnetic disturbances which take place in years of maximum sunspots may not be directly caused by any solar action, but may rather be due to the excessive meteorological disturbances which are likewise characteristic of such years. On the other hand, that magnetic and meteorological influence which Mr. Broun has found to be connected with the sun's rotation, points to some unknown direct effect produced by our luminary, even if we imagine that the magnetic part of it is caused by the meteorological. Mr. Broun is of opinion that this effect of the sun does not depend upon the amount of spots on his surface.

In the next place, that influence of the sun, in virtue of which we have most cyclones and greater meteorological disturbance in the years of maximum spots, cannot, I think (as far as we know at present), be attributed to a change in the heating power of the sun. We have no doubt traces of a temperature effect which appears to depend upon the sun-period, but its amount is very small, whereas the variation in cyclonic disturbance is very great. We are thus tempted to associate this cyclone producing influence of the sun with something different from his light and heat. As far, therefore, as we can judge, our luminary would appear to produce three distinct effects upon our globe. In the first place, a magnetic and meteorological effect, depending somehow upon his rotation; secondly, a cyclonic effect depending somehow upon the disturbed state of his surface; and lastly, the well-known light and heat effect with which we are all familiar.

If we now turn to the sun we find that there are three distinct forms of motion which animate his surface particles. In the first place, each particle is carried round by the rotation of our luminary. Secondly, each particle is influenced by the gigantic meteorological disturbances of the surface, in virtue of which it may acquire a velocity ranging as high as 130 or 140 miles a second; and lastly, each particle, on account of its high temperature, is vibrating with extreme rapidity,

and the energy of these vibrations communicated to us by means of the ethereal medium produces the well-known light and heat effect of the sun.

Now, is it philosophical to suppose that it is only the last of these three motions that influence our earth, while the other two produce absolutely no effect? On the contrary, we are, I think, compelled by considerations connected with the theory of energy, to attribute an influence, whether great or small, to the first two as well as to the last.

We are thus led to suppose that the sun must influence the earth in three ways, one depending on his rotation, another on his meteorological disturbance, and a third by means of the vibrations of his surface particles.

But we have already seen that, as a matter of fact, the sun does appear to influence the earth in three distinct ways—one magnetically and meteorologically, depending apparently on his period of rotation; a second cyclonically, depending apparently on the meteorological conditions of his surface; and a third, by means of his light and heat.

Is this merely a coincidence, or has it a meaning of its own? We cannot tell; but I may venture to think that in the pursuit of this problem we ought to be prepared at least to admit the possibility of a three-fold influence of the sun.

Even from this very meagre sketch of one of the most interesting and important of physical problems, it cannot fail to appear that while a good deal has already been done, its progress in the future will very greatly depend on the completeness of the method and continuity of the observations by which it is pursued. We have here a field which is of importance not merely to one, or even to two, but almost to every conceivable branch of research.

Why should we not erect in it a sort of science exchange into which the physicist, the chemist, and the geologist may each carry the fruits of his research, receiving back in return some suggestion, some principle, or some other scientific commodity that will aid him in his own field. But to establish such a mart must be a national undertaking, and already several nations have acknowledged their obligations in this respect.

Already the German Government have established a Sonnenwarte, the mere building and equipment of which is to cost a large sum. With an appreciation of what the spectroscope has done for this inquiry, the first directorship was offered to Kirchhoff, and on his declining it, Herr Vogel has been placed in charge. In France, also, a physical observatory is to be erected at Fontenay, on an equal, if not greater scale, of which Janssen has already accepted the directorship; while in Italy there are at least three observatories exclusively devoted to this branch of research. Nor must we forget that in this country the new observatory at Oxford has been so arranged that it can be employed in such inquiries. But what has England as a nation done?

Some years since, at the Norwich meeting of this Association, a movement was set on foot by Col. Strange which resulted in the appointment of a Royal Commission on the advancement of science, with the Duke of Devonshire as chairman. This Commission have quite recently reported on the steps that ought in their opinion to be taken for the advancement of scientific research.

One of their recommendations is expressed in the following words:—

"Important classes of phenomena relating to physical meteorology and to terrestrial and astronomical physics require observations of such a character that they cannot be advantageously carried on otherwise than under the direction of Government. Institutions for the study of such phenomena should be maintained by the Government; and in particular an observatory should be founded specially devoted to astronomical physics."

If the men of science of this country who procured the appointment of this commission, and who subsequently gave evidence before it, will now come forward to support its recommendations, it can hardly be doubted that these will be speedily carried into effect.

But other things besides observations are necessary, if we are to pursue with advantage this great physical problem.

One of these is the removal of the intolerable burden that has hitherto been laid upon private meteorologists and magnetic[illegible]. Expected to furnish their

tale of bricks, they have been left to find their own straw. Nothing more wretched can be imagined than the position of an amateur—that is to say, a man who pursues science for the love of it and is unconnected with any establishment —who has set himself to promote observational inquiries, whether in meteorology or magnetism.

He has first to obtain with great expenditure of time or money, or both, copies of the individual observations taken at some recognized institution. He has next to reduce these in the way that suits his inquiry; an operation again consuming time and demanding means. Let us suppose all this to be successfully accomplished, and a valuable result obtained. It is doubtless embodied in the Transactions of some society, but it excites little enthusiasm, for it consists of something which cannot be repeated by every one for himself like a new and interesting experiment. Yet the position of such men has recently been improved. Several observatories and other institutions now publish their individual observations; this is done by our Meteorological Office, while Dr. Bergsma, Dr. Neumayer, and Mr. Broun are recent examples of magneticians who have adopted this plan. The publication of the work of the latter is due to the enlightened patronage of the Rajah of Travancore, who has thus placed himself in front of the princes of India and given them an example which it is to be hoped they will follow. But this is only one step in the right direction; another must consist in subsidising private meteorologists and magneticians in order to enable them to obtain the aid of computers in reducing the observations with which they have been furnished. The man of science would thus be able to devote his knowledge, derived from long study, to the methods by which results and the laws regulating them are to be obtained; he could be the architect and builder of a scientific structure without being forced to waste his energies on the work of a hodman.

Another hindrance consists in our deficient knowledge as to what observations of value in magnetism and meteorology have already been made. We ought to have an exhaustive catalogue of all that has been done in this respect in our globe, and of the conditions under which the various observations will be accessible to outside enquirers. A catalogue of this kind has been framed by a committee of this Association, but it is confined to the dominions of England, and requires to be supplemented by a list of that which has been done abroad.

A third drawback is the insufficient nature of the present facilities for the invention and improvement of instruments, and for their verification.

We have, no doubt, advanced greatly in the construction of instruments, especially in those which are self-recording. The names of Brooke, Robinson, Welsh, Osler, and Beckley, will occur to us all as improvers of our instruments of observation. Sir W. Thompson has likewise adapted his electrometer to the wants of meteorology. Dr. Roscoe has given us a self-recording actinometer, but a good instrument for observing the sun's heat is still a desideratum. It ought likewise to be borne in mind that the standard mercurial thermometer is by no means a perfect instrument.

In conclusion, it cannot be doubted that a great generalisation is looming in the distance—a mighty law we cannot yet tell what, that will reach us we cannot yet say when. It will involve facts hitherto inexplicable, facts that are scarcely received as such because they appear opposed to our present knowledge of their causes. It is not possible perhaps to hasten the arrival of this generalisation beyond a certain point; but we ought not to forget that we *can* hasten it, and that it is our duty to do so. It depends much on ourselves, our resolution, our earnestness; on the scientific policy we adopt, as well as on the power we may have, to devote ourselves to special investigations, whether such an advent shall be realised in our day and generation, or whether it shall be indefinitely postponed. If governments would understand the ultimate *material* advantages of every step forward in science, however inapplicable each may appear for the moment to the wants or pleasures of ordinary life, they would find reasons patent to the meanest capacities for bringing the wealth of mind, now lost on the drudgery of common labours, to bear on the search for those wondrous laws which govern every movement not only of the mighty masses of our system, but of every atom distributed throughout space.

Dr. Moffat, in his paper "On the apparent connection between Sunspots, Atmospheric Ozone, Rain, and Force of Wind," stated that in discussing ozone observations from 1850 to 1869, he had observed that the maxima and minima of atmospheric ozone occurred in cycles of years, and that he had compared the number of new groups of sunspots in each year of these cycles with the quantity of ozone, and the results showed that in each cycle of maxima of ozone there is an increase in the number of new groups of sunspots, and in each cycle of minima a decrease. He also gave the following table to show that the years of maximum ozone and number of sunspots were generally distinguished by an increase in the quantity of rain and the force of the wind.

Mean daily quantity of Ozone for each year, the quantity of Rain, the number of new Groups of Sunspots, and mean daily Force of Wind, from 1850 *to* 1869, *both inclusive.*

Year.	Mean daily quantity of Ozone.	Cycles of max. and min. of Ozone.	No. of new Groups of Sunspots in each year.	Mean No. of new Groups of Sunspots with Cycles of Ozone.	Mean Annual Quantity of Rain with Cycles.
					inches.
1850	2·6		186		
1851	2·7		141		
1852	2·5	2·6	125	122	26·6
1853	2·0		91		
1854	3·4		67		
1855	0·9		28		
1856	0·7		34		
1857	1·2	1·1	98	90	24·4
1858	1·6		202		
1859	2·3		205		
1860	2·2		211		
1861	2·0		204		
1862	2·6	2·4	160	161	25·0
1863	3·5		124		
1864	2·0		130		
1865	2·4		93		
1866	1·7		45		
1867	1·5		25		
1868	1·7	1·6	101	99	29·4
1869	2·0		224	Rain this year	33·1

In the years 1867, 1868, and 1869 the rule with regard to rain does not hold good; this is owing to the great increase of sunspots and rain in 1869. It will be observed that the quantity of ozone increased with the increase in the number of new groups of sunspots.

In the years in which the mean number of new groups of sunspots is 174, the mean quantity of rain is 27·0 in.

In the years in which the mean number of new groups of sunspots is 65, the mean quantity of rain is 25·7 in.

In the years in which the number of new groups of sunspots is 174, the mean daily force of wind is 2·0.

In the years in which the number of new groups of sunspots is 65, the mean daily force of wind is 1·7.

ABSTRACT OF METEOROLOGICAL OBSERVATIONS AT TOKEI, JAPAN, 1874.

Lat. 35°; Lon. 139°; height of rain gauge above ground 33 ft.; above sea 50 ft.
Observer,— JOYNER, Esq., C.E.

	Rain.	Shade Temperature.		
		8 a.m.	2 p.m.	8 p.m.
	in.	deg.	deg.	deg.
January	2·38	32·8	42·7	36·5
February	2·18	35·6	45·9	39·8
March	7·57	42·7	50·0	45·2
April	4·65	52·3	60·5	53·4
May	6·49	61·4	68·9	61·9
June	9·88	71·7	77·2	70·3
July	5·34	76·4	81·2	73·8
August	3·29	80·8	82·2?	75·9?
September	9·74	69·5	76·1	69·4
October	10·19	56·1	63·6	57·3
November	2·56	43·8	54·7	47·6
December	5·80	36·3	47·0	40·8
Total	70·07	...	...	...
Mean per Month	5·84	54·9	62·5	56·0

REMARKS.—Typhoon on September 12th and 13th, with 2·25 in. of rain on 12th, and 3·00 in. on 13th. Min. observed temp. 19° on January 20th. Max. observed temp. 91° on August 18th; the latter is the 8 a.m. entry on that date, there being no afternoon observation; the true max. was probably higher.

THE RAINFALL AND FLOODS OF OCTOBER 9TH.

[THE republication of the following letter from the *Times* of October 13th may be permitted, on account of the condensed information it affords.—ED.]

Mr. G. J. Symons, 62, Camden-square, writes to us as follows:—"Considering the exceptional character of the rainfall and floods of July last even in the Midland district, it was scarcely to be expected that within two months, parts of those counties would be visited by a still greater rainfall. Such, however, has been the case, and I am glad to be able to furnish an account of what occurred, accurate, I believe, in all respects, and requiring only unimportant additions to render it complete. I purpose giving, first, the numerical facts; secondly, abstracts of the observers' remarks; and, lastly, a word or two of my own.

RAINFALL BETWEEN OCTOBER 9th, 9 A.M., AND OCTOBER 10th, 9 A.M.

Station.	County.	Depth. Inches.	Station.	County.	Depth. Inches.
Bath	Somerset	0·95	High St., Banbury.	Oxford	3·25
Marlborough	Wilts	1·32	King's Sutton, ,,	Northampton	3·08
Stroud	Gloucester	1·39	Northampton	,,	1·75
Minchinhampton	,,	1·65	Leamington	Warwick	1·63
Abingdon	Berks	1·44	Coventry	,,	1·70
Oxford	Oxford	1·94	Lutterworth	Leicester	2·12
Aylesbury	Bucks	1·50	Market Harborough	,,	2·15
Hereford	Hereford	1·06	Leicester	,,	2·17
Evesham	Worcester	1·88	Moseley	Worcester	1·22
Upper Heyford	Oxford	2·50	Tamworth	Stafford	1·14
Broughton, Banbury	,,	2·95	Wisbeach	Cambridge	0·31

OBSERVERS' NOTES.

Long Wittenham, Abingdon.—Rain all fell between noon and midnight, heaviest between 2 and 3 p.m. Heavy and sudden flood in the Upper Thames.

Hereford.—Nearly all fell before 9 p.m.

Evesham.—Rain commenced at 9 a.m. on Saturday, and fell without intermission until 11 p.m., the heaviest consecutive fall in ten years. The Avon rose rapidly, reached a *maximum* height of 9ft. 3in. above mean level on the 11th, at 6 p.m., and remained at that height with little variation for 24 hours. Rain began from N.E., and backed with the wind to W. at night, when it ceased. All the roads and meadows by the river are under water.

Upper Heyford.—The heaviest fall for at least ten years.

High Street, Banbury.—Highest flood known.

Broughton, Banbury.—Since August 1, 1867, the only falls of, or exceeding, 1½ in. have been,—1867, Aug. 15, 1·75; 1871, Sept. 29, 1·65; 1875, July 14, 1·50; July 20, 1·62; Oct. 9, 2·95; the fall of Saturday was, therefore, more than an inch in excess of any previously recorded.

Coventry.—The greatest fall here for at least nine years.

Ashby Parva, Lutterworth.—Upper and lower currents in nearly opposite directions, and great darkness when the rain began at 1 p.m.

Moseley, Birmingham.—Rain began at 11 a.m. on the 9th, and lasted just 12 hours. During the previous night the wind backed from S. through E. to N.E., and it was N.N.E. when the rain began, W. when it ended.

Wisbeach.—Rain only began at 11 p.m. on the 9th, and ended at 2 a.m. on the 10th, when there was a N.W. gale, pressure 6lb. on square foot.

SUMMARY.

The leading facts may be stated in a very few words. The fall was unusually heavy in Warwickshire, Leicestershire, and part of Worcestershire, and in the north of Oxfordshire and the south of Northamptonshire it was unprecedented. It is a remarkable and at present unexplained circumstance that, with only two intervening years, we have the two years 1872 and 1875, the former with a total fall of rain unequalled during the present century, and the latter with perhaps no very large total amount, but with torrential falls beyond all precedent."

EARTHQUAKE.

To the Editor of the Meteorological Magazine.

SIR,—We had a slight shock of earthquake in Upper Wensleydale, Yorkshire, N.R., at 10 p.m., on the 23rd of September. I have not seen any notice in the papers, so that the tremor may not have ex-

tended to any great distance. I mention it, therefore, in case no other correspondent may send you a note of it. There was a sound as of deep growling thunder, such as sometimes follows the sharper rattle, and shakes one's windows. Along with the rumbling noise there was a distinct vibration, causing the house and floor to shake perceptibly. I think it continued about three seconds. My wife felt it also; and I have since found that others in this neighbourhood have no doubt about its being an earthquake. A lady, *e.g.*, heard the china knick-knacks jingle in her room; and a gentleman six miles down the dale perceived it as he sat in his library, his dog at the same time jumping up on the hearthrug in evident alarm. Earthquakes are very uncommon in this part of the country.

By the way, in my register I have used to denote an Earthquake the usual symbol for earth, circle with diameter, and a wavy line touching circumference at top. I may say too that for Shooting Stars I put an arrow pointing downwards at an angle, with a star for feather. I do not know whether there are better symbols.—Yours truly,

J. D. P.

October 1st, 1875.

SUPPLEMENTARY TABLE OF RAINFALL IN SEPT., 1875.

[For the Counties, Divisions, Latitudes, and Longitudes of these Stations, see Met. Mag., Vol. X., p. 28.]

Station.	Total Rain.	Station.	Total Rain.
	in.		in.
Acol	1·80	Gainford	3·17
Hailsham	2·43	Shap	5·77
Strathfield Turgiss	1·90	Llanfrechfa	4·68
Addington Manor	2·37	Castle Malgwyn	4·67
Oxford	1·94	Heyope	4·34
Cambridge	2·37	Melrose	3·31
Sheering	2·84	Cessnock, Glasgow	4·94
Ipswich	2·44	Gruinart	3·41
Diss	2·44	Keith	4·73
Swaffham	2·40	Strathconan	3·66
Compton Bassett	3·08	Springfield, Tain	2·14
Hessary Tor, Dartmoor	6·12*	Skibbereen	8·30
Teignmouth	4·02	Glenville	8·29
Torrington	7·08	Kilrush	5·98
Trevarrick, St. Austell	...	Kilkenny	5·66
Taunton	2·84	Kilsallaghan	4·45
Cheadle	4·62	Twyford, Athlone	4·97
Ashby de la Zouch	3·28	Ballinasloe	5·54
Coston, Melton Mowbray	2·19	Kylemore	9·40
Bucknall	1·49	Bangor	4·81
Mansfield	2·95	Carrick on Shannon	4·73
Walton, Liverpool	5·05	Warrenpoint	8·40
Broughton-in-Furness	7·78	Bushmills	3·98
Stanley, Wakefield	2·70		

* Not reliable having been tampered with, probably 2 in. too little.

SEPTEMBER, 1875.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1860–5	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Date.	Min. Deg.	Date.	No. of Nights below 32°. In shade	On grass
			inches	inches.	in.								
I.	ENGLAND.	Camden Town	2·86	+ ·60	·78	23	15	80·8	18	44·2	29	0	0
II.		Maidstone (Linton Park)	2·20	— ·02	·54	22	11	86·0	18	46·0	29	0	...
,,		Selborne (The Wakes)	1·87	— ·57	·49	21	11	75·0	18	42·5	10	0	0
III.		Hitchen	2·07	+ ·21	·78	23	14	71·0	18*	43·0	28	0	...
,,		Banbury	2·38	+ ·01	·89	21	14	75·5	19	44·0	10	0	..
IV.		Bury St. Edmunds (Culford).	2·67	+ 1·06	·85	21	11	78·0	18*	43·0	28	0	0
V.		Bridport	3·35	+ 1·03	1·05	21	16	74·0	13	40·0	6‡	0	...
,,		Barnstaple	5·53	+ 1·77	1·30	17	18	79·0	8	47·0	9	0	...
,,		Bodmin	7·64	+ 3·97	2·74	17	17	76·0	13	46·0	11	0	0
VI.		Cirencester	2·80	— ·06	·77	21	11	...	...	...	...	...	...
,,		Shifnal (Haughton Hall)	4·14	+ 2·19	·83	19	16	72·0	7	42·0	29	0	0
,,		Tenbury (Orleton)	3·26	+ ·58	·69	23	17	75·7	17	37·7	29	0	0
VII.		Leicester (Belmont Villas)	2·77	...	·78	21	15	81·0	19	42·0	10	0	0
,,		Boston	2·24	+ ·67	·60	21	14	76·0	19	44·0	29	0	...
,,		Grimsby (Killingholme)	2·48	...	·63	21	13	70·5	7	43·0	29	0	...
VIII.		Manchester	4·74	+ 1·05	1·00	8	14	74·2	13	44·3	12	0	0
IX.		York	2·23	— ·10	·83	3	7	72·0	17	41·0	21	0	0
,,		Skipton (Arncliffe)	5·23	+ ·27	1·25	2	19	78·0	12	34·0	28	0	...
X.		North Shields	2·59	+ ·89	·71	8	15	70·3	7	41·8	30	0	0
,,		Borrowdale (Seathwaite)	14·45	+ 1·24	3·04	2	18	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely)	...	...	...	...	...	...	...	...	...	...	...
,,		Haverfordwest	6·29	+ 2·58	1·81	2	14	72·0	13	40·0	10	0	...
,,		Rhayader (Cefnfaes)	...	...	..	...	...	...	...	..	...	...	...
,,		Llandudno	4·65	+ 2·31	·85	2	16	78·0	7	47·7	11	0	...
XII.	SCOTLAND.	Dumfries (Crichton Asylum)	5·43	...	1·88	2	17	75·0	14	38·0	23	0	...
,,		Hawick (Silverbut Hall)	3·48	...	·86	3	13	...	...	...	...	...	...
XIV.		Kilmarnock (Annanhill)	5·66	...	2·24	26	15	73·8	14	40·5	23	0	0
XV.		Castle Toward	4·69	+ ·07	1·40	3	10	73·0	13	...	...	...	..
XVI.		Leven (Nookton)	3·05	+ ·57	·99	8	14	73·0	12	38·0	1	0	1
,,		Stirling (Deanston)	...	...	...	...	...	..	...	...	..	...	...
,,		Grandtully	3·29	...	1·30	8	9	...	...	..	...	...	...
XVII.		Braemar	4·12	+ 1·48	1·70	26	15	72·0	12	31·0	1	1	5
,,		Aberdeen	5·63	...	1·75	26	17	70·9	12	37·3	23	0	2
XVIII		Loch Broom	4·05	...	1·12	26	12	...	...	...	...	...	...
,,		Portree	4·76	— 6·00	1·23	25	17	...	...	...	...	...	...
,,		Inverness (Culloden)	2·65	— ·04	·95	27	15	72·7	12	36·4	1	0	3
XIX.		Helmsdale	1·88	...	·31	2	14	...	...	...	...	...	...
,,		Sandwick	2·86	— ·80	1·50	26	13	65·0	8	36·8	22	0	2
XX.	IRELAND.	Caherciveen Darrynane Abbey	10·61	...	2·13	21	17	...	...	...	...	...	...
,,		Cork	6·48	...	1·53	26	14	...	...	...	..	...	...
,,		Waterford	5·56	+ 2·43	1·00	22	14	70·0	13	44·0	12	0	0
,,		Killaloe	7·45	+ 3·29	1·65	26	20	76·0	1	37·0	10	0	...
XXI.		Portarlington	5·62	+ 2·34	1·56	27	27	71·0	7	40·0	11	0	...
,,		Monkstown, Dublin	3·61	+ 1·62	·71	23	13	...	...	...	...	...	...
XXII.		Galway	...	...	...	...	...	...	...	...	...	...	...
,,		Ballyshannon	3·35	...	·55	26	17	...	...	...	...	...	...
XXIII		Waringstown	3·73	...	1·30	26	17	75·0	1†	40·0	8,28	0	0
,,		Edenfel Omagh)	3·94	...	·94	26	17	69·0	13	33·0	28	0	...

* And 19. † 12 & 18. ‡ 9 & 11.

+Shows that the fall was above the average; —that it was below it.

METEOROLOGICAL NOTES ON SEPTEMBER.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

LINTON.—A remarkably fine, dry, hot month, up to the 22nd; the 18th being, with one exception, the hottest day in the year; after the 22nd it was mostly showery, with now and then brisk but not high winds. Distant T on 20th and 25th. Ther. indicated above 80° on the 8th, 17th, 18th, 19th, and 20th, while only on the last two nights did it fall below 50°. The bar. unusually high during the fine weather, fell to its lowest point on the 26th. Heavy dews frequent, but few fogs, and taken altogether it has been the finest September since the same month in 1865, which was warmer towards the end than this has been.

SELBORNE.—Fogs on most mornings, but generally disappearing before noon. The finest show of hops for the last 20 years, but greatly deteriorated since about the 20th, and in some of the gardens quite spoilt. Prevailing winds, from 4th to 17th, N., N.E., and N.W., thence to the end S.W. Faint L on 16th, at 7 p.m. T S and R at 3.30 p.m. on 19th; L at night on 25th; very high wind from S.E. on 27th, and T in after part of the day.

BANBURY.—Fog on 6th, 10th, and 11th; TS on 19th, and at 1 a.m. on 25th.

CULFORD.—Very dry weather up to the 21st. Easterly winds during 14 days, and severe T S on the 28th. Mean temp. of the month 58°·7.

BODMIN.—Average temp. 63°·3. R rather more than double the average of the last 26 years, and the heavy fall (2·74 in.) on the 17th has only been twice equalled here during that period.

HAUGHTON HALL, SHIFNAL.—After a copious rainfall on the 2nd, little fell till the 18th, the weather then delightful, allowing the gathering of the latter harvest in tolerable condition, but the wheat crop sadly deficient in yield. On the return of the R it fell daily, with the exception of the 25th, to the close, and on the evening of the 19th most violently, accompanied by a storm of T and L, more terrific than ever known here; the L both forked and sheet; so continuous that scarce a minute intervened. The rainfall was ·83 in. A heavy gale from S.W. on night of 26th; fog early on 8th, 20th, and 21st; easterly winds from 12th to 24th, all the rest from S.W., W., or N.W. Small tortoiseshell butterflies very numerous; scarcely a peacock or red admiral to be seen. Sand martins all gone on 17th. Still no mushrooms at the end of the month.

LEICESTER.—Very fine till the 20th; much lightning on the evening of the 19th, and a severe T S, at 1 a.m., on 25th.

BOSTON.—Very heavy gale on 24th, at night, and lightning; very stormy on 26th.

GRIMSBY.—A fine warm month; great quantities of fruit blown down by the storm of the 26th. Foot and mouth disease very prevalent. A very brilliant meteor seen at 8.30 p.m. on the 14th.

MANCHESTER.—T S on 8th, with 1·00 in. of R, and another on 19th.

ARNCLIFFE.—T S on 8th, with 1·22 in. of R, and T S on 19th.

NORTH SHIELDS.—T S on 8th, with ·71 in. of R, max. of month. T S on 20th; L on 24th; very high wind on 26th.

SEATHWAITE.—Exactly 6·00 in. fell during the first two days; L on 18th, and T S on 19th, but with little R.

WALES.

HAVERFORDWEST.—Although there were three rainfalls exceeding an inch this month, yet it was a fine month for harvest operations, and in excess of temp. for September. A very stormy period set in on the 18th, and continued with constant R and violent gales to the end of the month. On 2nd R commenced at 0.30 p.m., continuing till 9 p.m.; the fall in that time was ·71 in., R still fall-

ing; at 1 a.m. of 3rd, R falling in torrents, and again at 4 a.m.; total fall 1·81in.; 18th, more than ·50 in fell in half-an-hour; total fall 1·12in.; 21st another heavy fall, 1·06 in. These heavy falls caused the total for the month to be 2·58 in. above the average, but till the 21st there were nice dry periods between the falls, so rendering it a fine harvest month.

LLANDUDNO.—T S at 5 p.m. over the sea on 9th. A splendid meteor seen on 14th; sheet L on 16th, and TS on 17th; hurricane during night of 26th. Weather fine first three weeks. Temp. and R above the average.

SCOTLAND.

DUMFRIES.—Total fall double the average; 1·88 in. fell on the 2nd, being the heaviest fall not only of the month, but of the year; beginning and end of the month very wet; a period of fine settled weather in the middle of the month; no T. Temp. 2° higher than last year. Wind S.W. and W. during the last week.

HAWICK.—Heavy rains on 3rd (Teviot flooded), 8th, and 20th; squally from the 24th to the 30th. Potato disease bad in this district, and in the town of Hawick the scarlet fever has been very prevalent, and in many cases fatal.

ANNANHILL.—Bar. pressure higher than last month; temp. 4° lower. Rainfall heavy, 2·24 in. fell on 26th; great floods all over the country on the same night; and great storm from W.N.W. with T and L, the gale in some of its gusts reached 70 miles an hour, and a pressure of 25 lbs. to the square foot, the first gale of the autumnal equinox; ozone scarce. Good harvest, most of the fields in the lower district being cleared and the grain secured by the 15th. Foot and mouth disease among the cattle still prevalent, but less virulent. Death rate 18 per 1000 per annum; number of fatalities 36, the smallest number in any month since May, 1872; principal causes bronchitis and scarlet fever.

CASTLE TOWARD.—A dull month throughout, with little sun, heavy clouds and strong gales; towards the middle the weather broke up, and with sharp winds the cutting and ingathering of the crops went on rapidly, and the yards are now beginning to look comfortable for the coming winter; potato disease prevalent in this district; fruit of all kinds has been plentiful; turnips looking very well. Foot and mouth disease still prevalent among the cattle.

BRAEMAR.—A month of fine weather, with the exception of the usual equinoctial gales, which occurred on the 27th, accompanied by T and L from 2 to 5 a.m.

ABERDEEN.—Bar., temp., and rainfall all above the average, wind pressure rather below it; a month of mild, wet, and generally quiet weather, but heavy gales from 24th to 27th inclusive. On the 27th, the wind from 1 to 10 a.m., was terrible, some of the gusts rising fully to 12 (Beaufort). Fogs frequent, and heavy dews; T and L 4 to 7 a.m., amid dense fog, on the 9th; distant T S on 19th; T S 4 to 6 a.m. on 27th, the bar. being then at its lowest point.

LOCHBROOM.—The finest harvest month for 20 years; 16 continuous days without rain at this season is a valuable boon; the crops are all safely secured. The potato crop good.

PORTREE.—The finest September since 1868; the crops (except in patches on very late farms) secured in fine condition. Heavy gale from W.S.W. on 25th, from 5 to 7.30 a.m.; a heavy hailstorm on 27th, solar halo all day on 22nd.

SANDWICK.—Fine month, nearly all the rain falling on 26th.

IRELAND.

DARRYNANE ABBEY.—First half fine, having only four days wet; total fall 2·21. Second half very wet, being 8·40 in 13 days; the total 10·61 is much in excess of any month I have recorded, and the fall on 21st, 2·13, is the heaviest I have registered on one day, the nearest to it was 2·08, on September 1st, 1870; 6·19 fell in the 7 days 21st to 27th. All the rivers were much flooded, but no damage done by them, being short they fall on the slightest lull in the rain.

KILLALOE.—Tremendous floods on 26th, and much damage done to hay aud corn.

MONKSTOWN.—Heavy squall of wind and rain about 4 a.m. of 3rd; from 1st to

18th remarkably fine and bright, mornings cool and frequently foggy; 19th to the end rain almost continuous, though not very heavy.

BALLYSHANNON.—The month has been marked by heavy falls of rain of short duration, and strong easterly and southerly winds have been frequent; bar. unsteady throughout. Crops abundant.

OMAGH.—Weather up to 15th very fine and favourable, permitting as favourable a harvest as has been known within living memory to be secured in excellent condition; the remainder of the month strong squalls and unsettled weather, with occasional heavy rains.

THUNDERSTORM, SEPTEMBER 19TH.

To the Editor of the Meteorological Magazine.

SIR,—I was at Malvern on Sunday evening, and can bear testimony to the remarkable kind of lightning, exactly corresponding to the report of it by "R. H.," of whose letter in the *Birmingham Daily Post* of to-day, I enelose a copy. I think you will say it is worth reading.—Yours truly,

JAS. NUTTER.

Cambridge, Sept. 21st, 1875.

[Yes, and probably our readers will think so too.—ED].

To the Editor of the "Daily Post."

Sir,— A very remarkable thunderstorm came over the Selly district yesterday evening, being the eighteenth of this season, which I think merits a more minute description than that contained in your paper of this morning.

The day had been intensely hot, with scarcely a breath of air to relieve it. The afternoon became lowering, and it was evident that a tempest, as it is called, was impending. Between five and six o'clock a few precursory drops began to fall, and suddenly the whole expanse of sky was overspread with dense billowy clouds, which reduced us almost to darkness.

What is most remarkable about this storm was the great disproportion of the thunder to the lightning discharges. The latter were most brilliant, sometimes terrific. First came a flaming red ball, the ball being the nucleus, with a long comet-like tail, descending in the usual zigzag fashion, but attended with little or very faint thunder. After such a brilliant electric discharge you would have expected a crash as if the heaven and earth were coming together. Then would come a flash of sheet-lightning, lighting up the landscape like day, these flashes being followed and interspersed with a succession, at very short intervals, of some of the most beautiful coruscations of light my long-experienced eyes ever beheld. Every few minutes it literally showered electric balls of fire—splendid white light, strangely enough followed, not very quickly, by only slight rumbles of thunder. It also seemed strange that though the cloud must have moved on in the direction the storm was taking, all these discharges seemed to fall at about the same place, suggesting a strong feeling that, if there were any inhabitants about there, they were in some danger; and the direction was that of Edgbaston. I sat for fully half-an-hour watching this fascinating sight, and "soothly swore" that I never saw a more brilliant pyrotechnic display. Memory cheats us sometimes, but I thought at the time it was the most striking sight I had ever seen.

It may be remarked here that the present year is a strong parallel as regards thunderstorms with that of 1872. That singular year, both for storms and rain, had seventeen between April and July, and some three or four afterwards. This is the eighteenth of this season, of more or less intensity, from May to September inclusive.

September 20, 1875. R. H.

SYMONS'S
MONTHLY
METEOROLOGICAL MAGAZINE.

CXVIII.] NOVEMBER, 1875. [PRICE FOURPENCE, *or 5s. per ann. post free.*

THE RAINFALL OF OCTOBER.

Taken generally, October is England's wettest month, and the month just passed has assuredly maintained this characteristic. Reference to our usual Monthly Table shows, however, that though general, the excessive rainfall has been by no means universal. Kent, Suffolk, and Lancashire, have had little more rain than usual, and in N. Yorkshire, Northumberland, Cumberland, and parts of Scotland, there has been a deficiency. How, it will be asked, can this be reconciled with the constant reports of floods all over the country. There are two answers to this remark, firstly, that it is usual for that which is general to be considered as universal; and, secondly, there have been most exceptionally heavy and continuous rains, and they, in most cases, have fallen on saturated ground. The fall of October 9th was discussed in our last; the end of the year draws nigh, when it will be our duty to thoroughly describe the features of the rainfall of 1875, we therefore refrain from giving more than a few typical letters, and an abstract of the returns from Exeter, which is quite disheartening, and to other observers will, we hope, be a warning. If observers do not like, in accordance with Rule XVI., to obtain new rain gauges, they might at least see that when very heavy rains occur, the gauge is emptied before it overflows. As, however, they may be absent or asleep, the moral is obvious: Provide yourself with a gauge of ample capacity.

Rainfall in Exeter and the immediate vicinity, Oct. 19th.

STATIONS.	18th.	19th	20th	21st
Exeter Institution	·74	3·26	·20	·42
,, Manston Terrace ...	·75	? (1)	·37	·41
,, High Street	·75	? (2)	·21	·41
,, ,, ,, ...	·73	? (3)	·21	·41
,, Brampford Speke ...	·61	2·39	·22	·36
Topsham, Clyst St. George.	Fall fr	om 4th	to 21s	t, 5·50

(1)—Gauge overflowed.
(2) } Gauges overflowed; they held 2·75 in., so that the fall exceeded that, but by how
(3) } much is not known.

To the Editor of the Meteorological Magazine.

SIR,—A multitude of correspondence—alike trying to your time and patience to wade through—will, of course, reach you on the subject of the heavy rainfalls, with which most parts of this country have recently been visited; but as the more the information you receive the greater is the power afforded you of accurately judging the full nature and extent of the visitation, no apology is, I hope, necessary for contributing my mite to the general mass.

A wet period set in here on the 17th of September, and lasted up to the 30th of October. Out of the forty-four days constituting this period, rain was measured on thirty-two of them to the extent, in all, of 9·97 in. The rainfall for October alone was 7·36 in., an amount unprecedented, for the time, in my ten years' experience of this locality. Some of the falls, too, during the above-named time are specially worthy of notice, as, for instance, that of the 19th of September, when 0·62 in. fell in twenty minutes—accompanying a thunderstorm; and, again, that of the 2nd of October, 1 in. in two hours. The 1·16 in. taken on the morning of the 10th of October, was also the heaviest fall within twenty-four hours, I have ever yet recorded in that month. The Avon, which runs past my house within half-a-mile, overflowed its banks, and remained out for a longer time than I have ever known it, frequent as these over-flowings are.

I remain, Sir, yours truly,

F. BONNYCASTLE GRITTON.

Tytherton-Lucas, Chippenham, Wilts,
1st Nov., 1875.

P.S.—Appended is an abstract from my rainfall register.

Sept. 17 ... 0·01	Sept. 29 ... —	Oct. 11 ... 0·01	Oct. 23 ... 0·22
18 ... —	30 ... 0·01	12 ... —	24 ... —
19 ... 0·62	Oct. 1 ... 0·04	13 ... —	25 ... —
20 ... 0·06	2 1·00	14 ... 0·10	26 ... 0·87
21 ... 0·73	3 ... 0·23	15 ... —	27 ... 0·50
22 ... 0·11	4 ... —	16 ... 0·01	28 ... 0·19
23 ... 0·30	5 ... 0·02	17 ... —	29 ... —
24 ... 0·10	6 ... —	18 ... 0·38	30 ... 0·03
25 ... 0·01	7 ... —	19 ... 0·79	31 ... —
26 ... 0·05	8 ... 0·02	20 ... 0·12	
27 ... 0·38	9 ... 1·16	21 ... 0·61	Total ... 9·97
28 ... 0·23	10 ... 0·23	22 ... 0·83	

Total for October ... 7·36.

To the Editor of the Meteorological Magazine.

SIR,—This month has been by far the wettest observed by me during 24 years, the rainfall exceeding by 1·5 inches that of November, 1872. It has also afforded the wettest day (3·25 in. on the 9th) since 1860, when I began daily registration, and probably within living memory. The greatest daily rain I have previously had (1·65 in. on Sept. 29th, 1871), being very little more than half the amount. October has been the wettest month in the year five times since 1852, (in 1853, 4·25 in.;

1855, 5·03 in.; 1865, 4·08 in.; 1870, 3·84 in.; 1875, 7·80 in.;) but in no instance since 1860 until now, has the greatest daily fall amounted to 1 in. There have been only 18 instances of more than 1 inch of rain in the 24 hours since 1860. The average fall for October in 23 years was 2·62 inches: including the present, it has been 2·84 inches.

The morning of the 9th was very foggy. Temperature at 9 a.m., 50·3; bar., 29·386 (59°); wind S. and light. As the fog cleared away, light clouds were seen, and occasionally the sky became overcast, and a few drops of rain fell. About noon continuous rain began, the sky became very dark, and the rain soon fell in torrents, with hardly an interval of mitigation, until 10 p.m., when it measured 3·18 inches. Soon after this it nearly ceased; thus 3 in. fell in nine hours. The temperature during the rain was 43°. Towards evening, the wind, which had changed to E. and N.W., blew in gusts with great force, uprooting trees and dislodging chimney-pots. In the night the waters from the sources of the Cherwell, on the hills bordering the upper Cherwell valley, came down with such unwonted rapidity, that by 7 a.m. on the following morning, the Great Western Railway at the Banbury Station platform was two feet under water (not four feet, as reported by penny-a-liners). Across the line, which is raised several feet above the valley, the water rushed from the east, or Northampton side, and tumbled in a turbi-cascade into the river and meadows on the west, and thence across the towing path into the canal, where a heavily laden coal barge was swamped, and an empty one lifted on to the towing path lower down. At noon the flood had fallen considerably, but was still rushing with great velocity along the valley.

This flood had but just left our meadows, when, on the night of the 18th, heavy rain came on with high wind from S.E., continuing during the whole of the 19th and part of the 20th, the wind still S.E. The whole rain measured 2·54 inches. This brought another great flood, not quite so high with us, the greatest depth of water at G. W. R. station not exceeding one foot. But below us it was higher than the first, the former flood not having passed away.

Yours truly,

E. BEESLEY.

Banbury.

To the Editor of the Meteorological Magazine.

SIR,—I enclose a table of hourly rainfall for the wet week ending October 23rd, as recorded by my 12 inch electrical gauge, three feet above ground. As usual, when rain falls with easterly winds, we had no more than fell in the plains, and the quantity was insufficient to raise the river more than half the height to which it was raised by the storm of October 21st, 1874, when, I believe, no rain fell at York. The comparative absence of "Scotch mist" has been remarkable this

summer, and I doubt whether the rainfall in mountain districts will exceed the average, unless S.W. winds set in in December.

FENWICK W. STOW.

Hestholm, Bedale, Oct. 27th, 1875.

Rainfall at Hestholm, Wensleydale, for week ending October 23rd, 1875.

(12 inch gauge, 3 feet above ground, 465 above sea.

Hour ending (Gnwch time).	17	18	19	20	21	22	23	Total	Hour ending (Gnwch time).	17	18	19	20	21	22	23	Total
a.m.									p.m.								
1	...	...	·01	·01	·01	...	·03	·06	1	...	·01	·02	·02	...	..	·08	·13
2	...	...	·01	·03	·01	...	·09	·14	2	...	·01	·02	·05	...	...	·14	·22
3	...	...	...	·06	·01	...	·01	·08	3	...	·02	·03	·17	...	·02	·02	·26
4	...	...	...	·06	...	..	..	·06	4	...	...	·04	·18	..	·08	...	·30
5	...	...	...	·02	...	...	...	·02	5	..	·03	·01	·10	...	·04	·03	·21
6	.	...	·02	·01	...	...	...	·03	6	..	...	·05	·04	...	·09	·02	·20
7	...	·02	·07	·01	...	..	·01	·11	7	..	·01	·12	·05	·03	...	...	·21
8	...	·02	·09	·02	...	...	·01	·14	8	...	·03	·16	·07	·09	...	...	·35
9	..	·01	·01	·01	...	...	...	·03	9	...	·02	·04	·08	·04	·01	...	·19
10	...	·01	·01	...	...	...	·06	·08	10	...	...	·02	·06	...	·11	...	·19
11	...	·01	·02	...	...	..	·09	·12	11	...	...	·01	·10	...	·03	...	·14
12	...	·04	·03	...	...	...	·05	·12	12	...	·01	...	·05	...	·02	...	·08

Total same gauge measured at 9 a.m. (local time).

17th		18th		19th		20th		21st		22nd		23rd		Total.
·050	...	·405	...	·840	...	·995	...	·160	...	·580	...	·512	...	3·542

Total in 5 inch gauge at 1 ft., 3·57 inches.

To the Editor of the Meteorological Magazine.

SIR,—As the rainfall of October has been much above the average, I send you a comparative table of the last 10 years here :—

in.	in.	in.	in.	in.
1866...3·17	1868...2·16	1870...7·39	1872...3·88	1874...3·87
1867 ..3·83	1869...1·26	1871...3·24	1873...3·29	1875...6·74

From this it appears the fall has been much above that of other years, with the exception of 1870. There were only seven days without rain. The daily fall was as follows :—

	in.		in.		in.		in.
Oct.	1...0·11	Oct.	9... —	Oct.	17...0·05	Oct.	25...1·04
	2... —		10...0·06		18...0·50		26...1·34
	3...0·24		11... —		19...0·07		27...0·64
	4...0·02		12...0·06		20...0·18		28...0·20
	5... —		13...0·32		21...0·28		29...0·15
	6... —		14...0·08		22...0·14		30...0·16
	7... —		15...0·02		23...0·17		31...0·22
	8...0·25		16...0·44		24... —		
							6·74

I remain, your obedient servant,

SAMUEL P. WARREN.

The Parsonage, Balbriggan, Co. Dublin.

To the Editor of the Meteorological Magazine.

SIR,—I send you particulars of daily rainfall, June to October. The period is especially remarkable for the large quantities of rain falling in short spaces of time.

June 9–15	...	7 days	... 1·68 in.
,, 27–July 3	...	7 ,,	... 3·08 ,,
July 14–20	...	7 ,,	... 5·58 ,, (!)
Aug. 6–11	...	6 ,,	... 1·98 ,,
Sept. 19–23	...	5 ,,	... 2·96 ,,
Oct. 9–10	...	2 ,,	... 1·38 ,,
,, 18–22	...	5 ,,	... 3·69 ,, (!)
		39 days.	20·35 in.

Very respectfully,
JOHN THRUSTANS.

Merridale, Wolverhampton, Nov. 6th, 1875.

Rainfall at Wolverhampton, 1875.

	June. in.	July. in.	August. in.	September. in.	October. in.
1	—	0·30	—	—	0·08
2	—	0·81	—	0·31	0·10
3	—	0·37	—	0·35	0·21
4	—	—	—	—	—
5	—	—	0·08	—	0·05
6	0·02	—	0·21	—	—
7	—	—	0·49	—	0·02
8	—	0·02	0·39	0·30	—
9	0·25	0·41	—	—	0·97
10	0·35	0·18	0·13	—	0·41
11	0·11	0·13	0·76	—	0·03
12	0·37	—	0·07	—	0·05
13	0·31	—	0·05	—	—
14	0·01	1·19	0·13	—	0·21
15	0·28	0·38	—	—	0·04
16	—	—	—	—	—
17	0·06	0·11	0·02	0·05	—
18	—	0·66	—	—	0·64
19	0·08	0·45	—	1·45	1·36
20	—	2·79	—	0·12	1·00
21	—	0·03	—	0·70	0·30
22	—	—	—	0·05	0·39
23	—	0·14	—	0·64	—
24	—	—	—	0·06	—
25	0·02	0·15	0·09	0·10	—
26	—	—	—	0·02	0·37
27	0·24	—	—	0·13	0·32
28	0·43	—	0·22	0·19	0·38
29	0·82	0·02	—	0·03	—
30	0·11	—	0·11	0·05	—
31		—	—		—
	3·46	8·14	2·75	4·55	6·93

REDUCTION OF BAROMETER TO SEA LEVEL.

To the Editor of the Meteorological Magazine.

SIR,—In your September Magazine (which I saw yesterday for the first time), at the foot of page 120, your correspondent notices an error in my postscript (my letter to you under date, 23rd April); he is quite correct; a few hours after I sent you the proof of the above communication, I wrote to you that the co-efficient employed by Buchan (from Laplace), should be ·00222 in lieu of ·004; you replied that the correction was too late for that month, (the printing was earlier than usual on account of the Whitsun holidays), but it would appear as "errata" in the following magazine. The correction, however, did *not* appear as *promised*. Will you kindly put me right by mentioning this in your next impression?

Glaisher's Rain Gauge as per Mr. Rawson's letter in September Magazine.—The first gauge I had was one of these, I did not wait for the heavy rain, but before I fixed it, I poured a jug of water into the funnel and found only a few drops ran into the receiver, the bulk of the water forcing itself out in the way described by Mr. Rawson. I immediately had the bent tube straightened.

I am, dear Sir, yours faithfully,

KAUFMANN J. MARKS.

14, *Warrington Crescent, Maida Hill, W.*, 20*th October*, 1875.

EARTHQUAKE.

To the Editor of the Meteorological Magazine.

SIR,—At the same hour, three minutes to 10 p.m., of September 23rd, as mentioned by your correspondent "J. D. P.," I and all my household heard and felt very distinctly the shock of an earthquake, at Oughtershaw Hall, in Langstrothdale, Upper Wharfedale, 1,200 feet above the sea, 6 miles distant from Hawes in Upper Wensleydale.

In so remote a district, and at such an hour, our attention was at once called to the unusual sound, resembling the passing of heavily laden wagons. We went out of doors to assure ourselves more fully: the night was very dark, the day had been cool and stormy, after great heat and heavy thunderstorms during several preceding days. I did not observe any particular change in the barometer.

The same shock was heard and felt at Buckden, 6 miles distant, and at other places in the neighbourhood, and was recognised as an earthquake shock, as they are of no very infrequent occurrence. A very noted one took place on 15th December, 1859, which, from a number of observations I gathered at the time, seems to have traversed with its greatest intensity the line of the "great Craven Fault," near Settle, and forwards towards Greenhow Hill, by Grassington—a noted area of peculiar disturbance and upheaval.—Yours truly,

CHARLES H. L. WOODD.

Roslyn, Hampstead, N.W., 16*th October*, 1875.

THE BRITISH ASSOCIATION AT BRISTOL.

(Continued from page 141.*)*

Prof. Osborne Reynolds read a paper *On the Refraction of Sound by the Atmosphere*, in which he remarked that in previous papers he had pointed out that the upward diminution of temperature in the atmosphere (shown by Mr. Glaisher's balloon ascents to exist under certain circumstances) must refract and give an upward direction to the rays of sound which would otherwise proceed horizontally, and it was suggested that this might be the cause of the observed difference of the distinctness with which similar sounds were heard on different occasions, particularly of the very marked advantage that the night has over the day in this respect. On this subject he had made a series of experiments. He mentioned a case in which at sea, when leaving a yacht in a small boat, for the purpose of making experiments on sound, those in the yacht and the boat were able to call to one another, and be heard at a distance of three-and-a-half miles, and that the hiss and report of a rocket sent up from the yacht was heard at a distance of five miles. Also on the same occasion the barking of a dog on shore, which was eight miles distant, was heard, and the paddles of a steamer, which must have been fifteen miles off, were distinctly audible. Prof. Reynolds remarked that the distinctness with which sounds of such comparatively low intensity could be heard was perhaps beyond anything definitely on record, although remarkable instances of sounds heard a long way off were occasionally reported. As the result of a series of experiments made by means of an electric bell, Prof. Reynolds found that when the sky was cloudy and there was no dew, the sound could invariably be heard much further with, than against, the wind; but when the sky was clear, and there was a heavy dew, the sound could be heard as far against a light wind as with it. On one occasion in which the wind was very light and the thermometer showed 39° at one foot above the grass, and 47° at eight feet, the sound was heard 440 yards against the wind, and only 270 yards with it.

Dr. Janssen made some observations relative to *Mirage at Sea*. He had paid great attention to the phenomena in all his journeys since 1868, and had observed some very curious facts relating to mirage chiefly at sunrise and sunset. He found that (1) the mirage was almost constant at the surface of the sea; (2) that the appearances were explained by admitting the existence of a plane of total reflection at a certain height above the sea; (3) that the phenomena are due to a thermic and hygrometric action of the sea on the neighbouring atmospheric strata; (4) that there exist at sea direct, inverse, lateral, and other mirages; (5) that the phenomena have a very general influence on the apparent height of the sea horizon, which is sometimes diminished, sometimes increased. Considering the use made of the horizon in nautical astronomy it is very important to take into account this variation of the apparent horizon.

Prof. Hennessy, of Dublin, read two papers, one *On the influence of the physical properties of water on climate*, and the other *On the possible influence on climate of the substitution of water for land in Central and Northern Africa*. In the former the author referred to his earlier writings, in which he had taken an opposite view to Sir John Herschel, who stated that the effect of land under sunshine was to throw heat into the general atmosphere, and to distribute it over the whole earth, by the carrying power of the air, and that water was much less effective in this respect, the heat penetrating its depths and being there absorbed, so that the surface never acquires a very elevated temperature, even under the equator. Prof. Hennessy had arrived at the conclusion that of all substances largely existing in nature, water was that which was the most favourable to the absorption and distribution of solar heat throughout the external coating of the earth.

In his second paper the author referred to the fact that more than six years' since he had put forward proofs of the connection between some of the hot winds that blow from the south-west in Central and Southern Europe and the currents

of the Atlantic, and not with the Desert of Sahara, as has been usually supposed. Similar views had been enunciated by Prof. Wild, director of the Physical Observatory of Russia, and by others. The attention excited by the great midday heat of Central Africa caused many to overlook its remarkably low nocturnal temperature, and thus to ascribe to the desert a thermal influence that it does not possess. The author's views with regard to the physical properties of water in connection with climate, indicate that the substitution of an area of water over the Sahara for the existing dry land would be followed by the storing up of the heat received so largely in that region from the sun's rays which is now partly dissipated by nocturnal radiation. A great mediterranean sea in Africa would become a source of positive thermal influence on distant places. In the Red Sea the temperature is high by night as well as by day, and this would also occur in the hypothetical Mediterranean of the Sahara. The climatic effect of this sea would upon the whole result in a higher mean temperature for these parts of the globe, and it would undoubtedly not operate in producing a lower temperature in Europe so as to cause a descent of the snow line. Its operation would probably be the reverse.

In a letter from Mr. Meldrum, of Mauritius Observatory, written to accompany forty-nine tables respecting *Sunspots and Rainfall* (which, however, had not arrived), he expressed an opinion that the evidence adduced in favourof a rainfall periodicity was so strong that he believed we should by and bye be able to predict the general character of the seasons.

The Report of the Committee on Luminous Meteors, was read by Prof. Herschel, it related, as usual, to meteors doubly observed, and to aërolites, the portion having reference to the latter being the more interesting, as the falls of aërolites which have been placed on record since the last report were more than ordinarily numerous.

During the annual meteor showers of the past year, very unfavourable weather generally prevailed for recording meteor tracks, and few meteors were seen on those nights when the usual expectations of their appearance were entertained. A thorough examination of all the observations collected by the committee since the publication of the Meteor Atlas in 1867, with the view of extending and correcting the list of general and occasional meteoric showers which it embraced, has been continued with satisfactory results under the direction of Mr. Greg. The report also contained a *résumé* of the contents of the recent publications on the subject of meteoric astronomy.

Mr. Glaisher remarked that the report was the result of considerable labour performed by Prof. A. S. Herschel, but he pointed out that the work of properly treating meteor observations had now become so great as to be beyond the power of the Association to grapple with, and alluded with satisfaction to the arrangements being carried out by M. Leverrier. A discussion took place on the connection of comets and meteors, in the course of which Sir William Thompson said that there was nothing to justify the assertion that the mass of comets was so small as was sometimes supposed, and he considered there was good evidence for believing that the comet's tail was really a train of meteors.

The Report of the Committee on British Rainfall, was epitomized by the Secretary, Mr. G. J. Symons, it began by giving a *résumé* of the rainfall work done in connection with the British Association during the last fourteen years. It then referred to the steps takenafter the meeting at Belfast to obtain additional stations in Ireland, which were so successful that the Committee received 190 offers of assistance The acceptance of all these offers would have involved an expenditure far beyond the funds at the disposal of the committee, and they were therefore reluctantly compelled to make a careful selection, resulting, however, in the establishment of sixty-six stations, many of them in localities of extreme importance. In the past fifteen years the number of stations had been raised from 241 to nearly 2,000. The influence of size and shape on the indications of rain gauges had been experimentally examined, and also the effect of height above ground. The laws which

regulate the seasonal distribution of rainfall had been, to a certain extent, ascertained. The secular variation of annual fall had been approximately determined. A code of rules had been drawn up for observers. Nearly 250 stations have been started at the cost of the Association, and 629 stations have been visited, and the gauges examined by the secretary. The Committee had obtained and supported observations on mountain tops, and places difficult of access, where no observations had been made, in Cumberland, Westmoreland, Wales, and Scotland, and also an extensive series in Ireland. When the works actually in hand are completed, they will furnish an index to all the observations hitherto made, and be invaluable to future enquirers.

Captain H. Toynbee, F.R.A.S., F.R.E.S., Marine Superintendent of the Meteorological Office, read a paper on the *Physical Geography of that part of the Atlantic Doldrums which lies in the Track of Ships crossing the Equator.* The paper was accompanied by monthly diagrams, which showed :—1st. The isobaric lines of mean pressure for each ·05 of an inch, together with arrows showing the prevailing winds and their force. 2nd. The isothermal lines for every two degrees of air temperature. 3rd. The isothermal lines for every two degrees of sea temperature, together with arrows showing the prevailing currents and their speed in twenty-four hours. The paper called attention to important facts relating to atmospheric pressure, temperature, wind, currents, weather, sea, clouds, natural history, earthquakes, &c. The diagrams may be said to give the navigator a monthly picture of the Doldrums, clearly showing him how in some months they are wedge-shaped (as remarked by the late Commodore Maury), and enabling sailors to select the best route across the Equator. They also illustrate the action of both air and water when meeting, as is constantly the case with the two trade winds, showing how the air as well as water seems to eddy round a point of land from which the main stream is running. The district is the birthplace of many West India hurricanes, and on the diagram for August the place in which one originated was pointed out, which was afterwards traced to the Island of St. Thomas. The whole paper was a *résumé* of a large book about to be published by the Meteorological Office.

Mr. F. Galton said that the work of the Meteorological Office was a national work, and the £10,000 a year granted by Government to the office was really a very small sum compared with the amount paid by the United States for similar purposes.

Col. Carrington said that the Government of the United States had not only enlarged its facilities for home signal service, but they had recently sent two frigates across the Pacific to obtain soundings, in order to determine the practicability of establishing a Pacific telegraph.

Professor Hennessy considered that all recent researches tended to prove that the old theory of water being colder than the air and decreasing the temperature was incorrect, and that the water really was warmer than the air.

Dr. Carpenter considered it a remarkable circumstance that in the equatorial Atlantic, even in the month of August, the sea temperature was not higher than he had seen it in the same month in the Mediterranean, namely, 75°, while in the Red Sea it rose to nearly 25° above that figure. He accounted for this by the theory of a constant upward movement of the glacial water in the equatorial region, which kept down what would otherwise be a Red Sea temperature in the Atlantic.

The Wind and Gravitation Theories of Oceanic Circulation, by Mr. Jas. Croll. The paper stated that the researches of the Challenger Expedition bring to light the striking fact that the general surface of the North Atlantic to be in equilibrium must stand at a higher level than at the Equator; in other words, the surface of the Atlantic is lowest at the Equator, and rises with a gentle slope to well nigh the latitude of England—a result which proves the physical impossibility, in so far as the North Atlantic is concerned, of any general interchange of Equatorial and Polar water due to gravitation. Another fact irreconcilable with the gravitation theory is the fact that the warm water is all in the North Atlantic. According to the wind theory of oceanic circulation, however, the

whole of the phenomena are easily explained. Owing to the fact that the south-east trades are stronger than the north-east, and blow constantly over upon the northern hemisphere, the warm surface water of the South Atlantic is drifted across the Equator. It is then carried by the equatorial current into the Gulf of Mexico, and afterwards of course forms a part of the Gulf Stream. The North Atlantic, on the other hand, not only does not lose its surface heat like the equatorial and South Atlantic, but in addition it receives the enormous amount of heat constantly carried into it by the Gulf Stream.

Bearings of Recent Observations on the doctrine of Oceanic Circulation. Dr. Carpenter delivered an address on this subject. Referring first to Mr. Croll's paper, he said that there could be no doubt that a horizontal circulation existed in the North Atlantic, produced by the winds, but it was merely on the surface and did not affect the doctrine of a general oceanic circulation. Mr. Croll's contention that in order to have equilibrium the water at the Equator must be lower than further north, was an assumption which was open to considerable question, for he (Dr. Carpenter) maintained that there was a constant disturbance of equilibrium, just as in a boiler of water when fire was placed under it. Dr. Carpenter then described his theory of a general oceanic circulation, and after referring to the facts which had led him to his conclusions, said that the voyage of the Challenger showed, as he had predicted, that on the border of the Antarctic regions there is a surface stratum of cold water caused by the influence of the warmer water below and the sun melting the ice, but that cold water is lighter than the warm water below, because it is much less saline. The lower stratum of water of 36° could only be accounted for by the supposition that it was brought there by a force which drew it into the polar area. The address was almost wholly a repetition of previous addresses on the same subject.

Sir Wm. Thompson said that Dr. Carpenter's demonstration of his theory was most conclusive. The reasons he had given were utterly irrefragable. He hoped some attention would be paid to the question *where* the cold surface current, the warmer north current, and the cold southern under-current met.

REVIEWS.

Annual Report of the Chief Signal-Officer, to the Secretary of War for the year 1874. Washington: Government Printing Office, 1874. 8vo, 403 pp., 64 plates.

If any readers doubt that it is possible to make Meteorology popularly interesting, they had better try to obtain a copy of the above work, and we undertake that they will be convinced before they have read half of Sergeant Seyboth's record of the observatory on Pike's Peak, Colorado, 14,093 ft. above sea level. As perhaps all may not be able to see the original work, we quote the remarks on one fairly average week :—

"May 22nd. Summer appears to have commenced at last, even on Pike's Peak, for throughout to-day the thermometer stood above 30°, and reached a maximum of 42° at noon. Base Station reports a maximum of 93°. Two thunderstorms passed below the Peak, both advancing from the north-west to the south and east, and disappearing in the north-east. Sunset was extremely beautiful; rose colored streamers like festoons extended from clouds to plains in fantastic combinations, exhibiting splendid contrasts of light and shade.

"May 24th. A heavy thunderstorm passed slowly and directly over the Peak between 10 a.m. and 3 p.m.; the temperature declined during its passage, and large sparks passed constantly through the lightning-arrester, while a strange crackling of the snow could be heard at all times. While making the 2 p.m. out-door observations, I heard the snow crackle as mentioned, and at the same

time I felt on both temples, directly below the brass buttons on my cap, a pain as if from a slight burn; putting up my hands there was a sharp crack, and all pain had disappeared.

"May 29th. A violent thunderstorm, accompanied by sleet, passed over the Peak from south-south-east to west-north-west. It came upon us so suddenly that I had barely time to cut out the telegraph instrument before blinding flashes of fire came into both rooms from the lightning-arrester and stoves; loud reports followed in rapid succession, while outside the noise of thunder claps was almost drowned by the rattling of the indescribably heavy showers of sleet which followed each discharge. The storm appeared to surround us in all directions. At 7 p.m. a bolt struck close to the north window, and at the same time a heavy discharge took place through the lightning arrester which made me for a moment believe that the building itself had been struck, and was on fire; a cloud of smoke filled the embrasure of the north window which was afterwards found to have resulted from the melting of the rubber insulation on the office-wires. On account of the smallness of the office room, I considered it safer to retreat to the kitchen, where I found both assistants about to run, under the belief that the house was on fire. After this discharge the storm passed slowly to the westward, and we were already beginning to breathe more freely, when the wind veered to the south-west and brought back the storm in all its fury.

We are, however, bound to regard this report solely from a scientific stand-point, and we are glad to say that in this aspect also it will bear favourable comparison with any similar work. General Myers and his staff are very wise in developing to the utmost the relation of Meteorology to practical life, and in quoting in their reports not merely the usual meteorological data, but circumstances affected thereby, such as the temperature and level of rivers, their obstruction by, or freedom from, ice; the influence of rains on cereal and other crops, &c. We do not notice any detailed account of the position, mode of mounting, or pattern of the instruments employed, but this information may have been given in some other publication which we have not received. It would be certainly more interesting to Meteorologists than some of the documents which go to swell this bulky volume—*e.g.*, than the paper giving the Code words. If, however, this and all the necessary papers referring to questions of discipline, list of sergeants who have passed their examinations, and all others inseparable from a military system be expunged; the residue is a useful storehouse of well-arranged facts, illustrated by a large number of maps and diagrams equally good in design and execution.

Stanford's Orographical Map of the British Isles. Edited by PROF. A. C. RAMSAY, LL.D., F.R.S. Single sheet, 5ft. by 4ft. Stanford; London, 1875.

A SHORT time since, in answer to a casual question respecting some place in the Tyrol, the writer carelessly replied, "Oh, I know my own country far better than any foreign part." The questioner, who was a travelled Englishman, replied that he thought that that soon would be, if it was not already, a proud thing to say, considering how people now swarmed along beaten tracks abroad, and left the beauties of their native land unknown and unheeded. The advantage of repeating this bit of gossip may not be obvious, and it may therefore be well to

remark that it is only quoted as a species of credential, for surely those who know a country best are likely to be the most competent critics of its graphical representation.

The qualifications of a map are accuracy, distinctness, and neatness of execution.

If the Ordnance Survey Office had published the 6 inch maps for the whole kingdom, the duties of the Editor of this map would have been merely to see that the various contours were properly transferred; but as there are only a few counties for which these details are published, all kinds of original data must have been utilized, and the labour of compilation excessive. We are glad to find that extreme accuracy has been attained even in those parts where the Ordnance authorities have hardly done anything. We have examined at least a dozen localities where errors were probable, and have only found one case which could be improved if the draughtsman went to the spot. The 250 ft. contour is a trifle too far inland, near Ilfracombe; Hillsborough, which is a mile or two east of Ilfracombe, must be quite 400 ft., and is almost precipitous to the water's edge. Our readers will realize the hypercriticism of this remark when we state that this error arises from a deviation of perhaps 0·05 in. in a map comprising about 3000 square inches. We need not, and probably could not, give higher testimony to the accuracy of the map.

In point of distinctness, there is nothing to complain of, except, perhaps, that one of the colours is scarcely true to its name. The text says :—

Land below 250 ft., light green.
,, 250 ft. to 500 ft., dark green.
,, 500 ft. to 2000 ft., burnt sienna.
Land above 2000 ft., red.

But the pale green is so pale that it would pass equaly well for pale yellow. The colours are well chosen, and the general effect is very good, as is also the execution of the work.

In a spare corner south of Ireland there is a rainfall Map of the British Isles on a reduced scale—about 90 miles to an inch—tinted to show six separate districts—viz., those where the rainfall is (1) below 25 in., (2) between 25 in. and 30 in., (3) between 30 in. and 40 in., (4) between 40 in. and 50 in., (5) between 50 in. and 75 in., (6) above 75 in.

BOOKS RECEIVED.

AUSTRALIA.

ELLERY, R. L. J. Results of Observations in Meteorology, Terrestrial Magnetism, &c., taken at the Melbourne Observatory during the year 1872. 8vo.

RUSSELL, H. C., B.A., F.R.A.S. Meteorological Observations made at the Government Observatory, Sydney, Jan.–April, 1875.

BELGIUM.

QUETELET, E. Note sur la direction de l'Aiguille Aimantée à Bruxelles en 1875. 8vo.

,, Annales de l'Observatoire Royale de Bruxelles. Août 1875. 4to.

OCTOBER, 1875.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1860–5	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Date.	Min. Deg.	Date.	No. of Nights below 32°. In shade	On grass
			inches	inches.	in.								
I.	ENGLAND.	Camden Town	4·35	+ 1·76	·79	18	18	70·2	5	32·8	13	0	0
II.		Maidstone (Linton Park)	3·85	+ ·75	·91	2	19	67·0	5	32·0	12†	3	...
,,		Selborne (The Wakes)	5·83	+ 1·62	1·45	19	18	64·5	5	32·5	17	0	4
III.		Hitchen	3·94	+ 1·39	·96	9	15	63·0	5	31·0	12	2	...
,,		Banbury	7·80	+ 5·37	3·25	9	18	67·0	5	29·0	13	..	3
IV.		Bury St. Edmunds (Culford)	3·24	+ ·53	·74	2	14	69·0	5	30·0	11‡	4	6
V.		Bridport	7·19	+ 3·16	·90	26	25	66·0	4, 5	30·0	10	...	...
,,		Barnstaple	6·40	+ 2·28	·95	1	27	66·0	20	39·0	29	0	...
,,		Bodmin	9·06	+ 3·74	1·80	26	25	63·0	5	38·0	13	0	...
VI.		Cirencester	7·82	+ 4·33	1·74	9	16	...	...	...	...	...	...
,,		Shifnal (Haughton Hall)	5·32	+ 3·08	1·27	19	18	66·0	21	32·0	12‖	3	6
,,		Tenbury (Orleton)	5·94	+ 2·71	1·04	19	20	67·5	4	29·2	13	2	7
VII.		Leicester (Belmont Villas)	5·78	...	2·24	9	17	65·8	4	30·8	13	1	..
,,		Boston	3·50	+ 1·38	1·39	20	13	68·0	5	34·0	12	0	...
,,		Grimsby (Killingholme)	4·16	...	1·15	20	20	64·0	4	31·0	13	1	...
VIII.		Manchester	4·46	+ ·65	·90	19	14	64·8	1	30·8	14	4	5
IX.		York	4·21	+ 1·69	1·25	20	17	67·0	21	31·0	11	1	..
,,		Skipton (Arncliffe)	5·14	— 1·52	·82	19	23	62·0	1	28·0	12	4	...
X.		North Shields	3·26	— ·02	·90	20	22	65·3	1	31·0	13	2	3
,,		Borrowdale (Seathwaite)	10·08	— 6·24	2·21	10	19	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely)	8·03	+ 2·28	·93	22*	24	...	...	...	...	...	...
,,		Haverfordwest	7·28	+ 2·09	·80	22	24	62·5	3	32·5	15	0	4
,,		Rhayader (Cefnfaes)	...	...	...	...	...	...	...	...	...	...	...
,,		Llandudno	5·30	+ 1·34	·85	11	20	66·5	1	36·4	14	...	...
XII.	SCOTLAND.	Dumfries (Crichton Asylum)	4·82	— ·35	·97	20	19	63·7	2	29·0	13	2	4
,,		Hawick (Silverbut Hall)	2·54	...	·29	19	21	...	...	...	...	...	...
XIV.		Kilmarnock (Annanhill)	3·72	...	·46	26	19	59·7	9	31·2	10	2	4
XV.		Castle Toward	6·72	+ ·97	·90	18	19	62·0	1	...	...	...	..
XVI.		Leven (Nookton)	4·03	+ ·28	·56	13	24	62·0	1	30·0	12	0	7
,,		Stirling (Deanston)	...	...	...	...	...	...	...	...	...	...	...
,,		Grandtully	6·27	...	·80	22	28	...	...	..	...	...	...
XVII.		Braemar	5·54	+ 2·79	·59	14	27	58·8	5	25·8	12	3	8
,,		Aberdeen	4·10	...	·51	13	25	62·5	4	31·2	12	2	4
XVIII		Loch Broom	2·97	...	·66	5	15	...	...	...	..	...	...
,,		Portree	5·31	— 5·47	·98	8	21	...	...	...	...	...	...
,,		Inverness (Culloden)	1·33	— 1·33	·30	7	22	60·5	8	29·0	31	5	11
XIX.		Helmsdale	3·44	...	·85	12	24	...	...	...	...	...	...
,,		Sandwick	3·76	— 1·16	·65	6	24	57·5	8	35·8	13	0	4
XX.	IRELAND.	Caherciveen Darrynane Abbey	6·96	...	1·25	29	24	...	...	...	...	...	...
,,		Cork	6·69	...	1·40	26	23	...	...	...	...	...	...
,,		Waterford	9·89	+ 5·49	1·57	31	22	66·0	4	30·0	15	...	...
,,		Killaloe	5·06	+ ·04	·55	2	22	67·0	4	31·0	17	...	...
XXI.		Portarlington	4·71	— ·42	·76	19	29	60·5	7	31·5	13	1	...
,,		Monkstown, Dublin	7·64	+ 3·72	1·19	26	25	...	...	...	...	...	...
XXII.		Galway	3·57	...	·45	17	23	...	...	...	...	.	...
,,		Ballyshannon	4·54	...	·60	27	22	...	...	...	...	...	...
XXIII		Waringstown	3·93	...	·65	26	24	63·0	8	30·0	11	5	5
,,		Edenfel Omagh)	5·13	...	·91	26	20	59·0	4	29·0	9§	5	...

* And 26. † 13 & 25. ‡ 12. ‖ 17. § 11 & 12.

+Shows that the fall was above the average; —that it was below it.

METEOROLOGICAL NOTES ON OCTOBER.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

LINTON.—The beginning and middle of the month mostly wet, with a flood in the river about the 22nd; slight frosts on the 12th, 13th, and 25th, but not severe enough to injure geraniums out of doors. Bar. very low and unsteady from 9th to 16th, without any apparent cause for it being so. Winds changeable, but never very high; on the whole the month not remarkable for October.

SELBORNE.—Bar. higher on the 6th than it has been since the 1st of April; frost on grass on 11th, 12th, 17th, and 25th; fog on 1st, 12th, 19th, 20th, 25th, and the last four days of the month. Prevailing winds first half of the month S.W., towards the end S.E. to N.E. A gloomy, cheerless, foggy month.

BANBURY.—T on 2nd; great fall of R (3·25 in.) on 9th, during the continuance of which the temp. fell from 50°·3 to 43°·0. On the following day the greatest flood this year, nearly 2 inches of R fell during the 19th and 20th; followed on the 21st by a great flood R and sleet on 27th.

CULFORD.—High wind on 9th and 18th; T on 11th. A month of comparatively sunless weather, particularly as regards the latter part of it. Easterly winds prevailing on 18 days. Mean temp. of the month 48°·8.

BODMIN.—Mean bar. 29·74 in.; mean temp. 52°·9. R 3·40 in. above the average of the preceding 26 years.

SHIFFNAL.—An unusually wet October (5·32 in.), the most so (with the exception of 1872, when 6·07 in. was registered) for 40 or more years; the R with which September closed continued to fall on the first three days, then a lull till the 9th, when a fall of ·76 in. (unusual from N.) took place; followed by the first frost, on 12th, for three nights, cutting down dahlias and tender plants; after a short interval R again set in on 17th, falling daily (except on 24th and 25th) to the 29th. The fall from evening of 18th to morning of 21st was incessant, amounting to 2·47 in.; wherever streams run the land was greatly flooded. In spite of the cold R, figs ripened on the outer walls, owing to the warmth of the early season. Most of the R came from the N.E. or S.E. Bar. remarkably equable throughout.

ORLETON.—A very cloudy, wet, and gloomy month, with several great and long continued falls of R; the total fall (5·94 in.) is the greatest ever registered, in the same month, since 1830. Only twice in the 45 years has it reached 5 in., viz., in 1848, 5·04 in., and 1855, 5·72 in. The river Teme was frequently full, and was much flooded on 20th and 21st. Bar. was uniformly low till the 8th, and very steady. The first week was warm, but generally cloudy; the remainder of the month was cold, with very little sunshine, the mean temp. of the month being below the average.

LEICESTER.—On 9th, an unusually heavy fall of R (2·24 in.), lasting 10 hours, and causing a very high flood; the heavy fall (·81) on the 20th also caused a flood, but not so high. Exactly 22 in. of R have fallen since the 1st of June.

BOSTON.—The floods, which have been so destructive in other parts of England during the month, have not been felt in this neighbourhood. A strong freshet has been running down the Witham, but the waters have not risen sufficiently to flood any of the land; the excellent arterial drainage of the Fens has proved to be thorough, and clearly shows what can be done to regulate the storage and discharge of the rainfall.

GRIMSBY.—9th, the fine weather broke up this day; the bar. falling with a N. wind; whilst the clouds were coming from S. Woodcocks arrived on 15th; wild swans seen on the Humber on the same date; a pair of grey crows seen on 19th. L in the N.E., at night, on 22nd. The end of the month very cold and wet. Foot and mouth disease still very prevalent amongst cattle.

WALES.

HAVERFORDWEST.—A very stormy, wet month, almost incessant R, with violent gales, especially at night; no single fall of great magnitude (·80 in., on 22nd, being the max.). Cold easterly winds, with much downfall, during the last 14 days of the month. No frosts, except slight white ones on a few mornings.

LLANDUDNO.—The general character of the month was cold and wet, though eight days are entered in my register as very fine. Rainfall nearly an inch in excess, and the temp. 1°·3 below the average. Greatest fall was ·85 in. on 11th, with T and L.

SCOTLAND.

DUMFRIES.—The fall of R has been about the same as that of October, 1874; the temp. is half-a-degree less. There was hoar frost on several mornings in the early part of the month; once H, and twice T. The month generally has been wet and disagreeable.

HAWICK.—A wet month, with cold E. winds. Frost on the nights of the 11th and 12th. Potatoe crop fully half lost from the disease.

ANNANHILL.—Bar. pressure and temp. below that of last month; R moderate; winds principally E. and S E. Several gales during the month; strong gale on the night of the 5th; S.W. and S.E. gales on 10th, 20th, and 22nd. Limes, planes, oaks, &c., divested of leaves. Pastures still fair, but foot and mouth disease prevalent to some extent. Scarlatina also prevalent in the district.

CASTLE TOWARD.—A dull, disagreeable month throughout, with cold piercing winds; being easterly most of the month; every advantage was taken of it for lifting potatoes. Turnips look well, and every appearance of a good crop. Fruit trees casting leaves earlier this season. The forest trees also are bare, and everything has a wintry look.

BRAEMAR.—An unusually wet, damp month, just double the average amount of R.

ABERDEEN.—T and L at 5 a.m. on 12th; bar. pressure below the average (19 years) temperature, and rainfall above it; E. and S.E. winds greatly in excess of average. A wet and stormy month, with a comparatively high temperature; heavy easterly gales, with little intermission, from 14th to 31st.

LOCHBROOM.—Our September was beautiful, but nothing could exceed this month, especially down from the 12th to the 31st, during which time we have only had ·09 in. of R.

PORTREE.—The first 10 days were wet, but none of the gales that were so much felt on the S.E. and N. coasts reached here. Heavy H on 6th; frost every day from 13th to 17th. The crops are all secured, and much above the average. Potatoes very abundant, and are now selling at 3d. per stone. Cattle and sheep well, and thriving well on the pastures.

CULLODEN.—L on nights of 2nd and 6th. Auroræ on seven nights. Thick fogs on the mornings of 12th and 13th.

SANDWICK.—The rainfall of October has been fully an inch less than the average of the last 34 years, while there have been great floods in various parts of England. The most remarkable feature of the month was the persistence of S.E. winds, which commenced here on the morning of the 13th, and not only blew to the end, but still blow, after completing three weeks; it never exceeded about 40 miles an hour here, but its continuance, without intermission, put the German Ocean in an awful rage, while the Atlantic on our western shores has been as smooth as a lake.

IRELAND.

DARRYNANE.—Rainfall about the average; wind variable, generally moderate, but on 3rd a gale from S.W.; 5th and 6th from N.W.; also on 9th and 11th; from S.E. on night of 17th and 18th; also on 28th and 29th. Sea generally rough; last few days very foggy. Starlings migratory here seen on 15th; blackbirds (also migratory) on 19th; woodcocks on 17th.

WATERFORD.—25th to the end, winds varying during these days, from N.E. by E. to S.E. and S., but with a min. temp. never below 45°, but on two occasions 50°, and on others 49° and 48°.

MONKSTOWN.—The heaviest monthly rainfall I ever registered since I commenced in 1864; the last week is unparalleled in quantity, almost 3 in. in three days; the total for the week being 4·13 in. This month is also noteworthy from the fact that on two occasions upwards of 1·00 in. of R fell in 24 hours. The bar. has been fairly high during all the R, which came with a south-easterly wind.

BALLYSHANNON.—The month has been chiefly marked by high winds and low temperatures. River Erne unusually swollen for this season, owing to constant heavy R.

WARINGSTOWN.—Wet and stormy, except the second week, which was very fine. Temp. rather above the average.

EDENFELL, OMAGH.—Weather generally rainy, though not remarkably so till the last week, when during three consecutive days, nearly two and a quarter inches fell. We have, however, been saved in the N.W. of Ireland from the great damage occasioned elsewhere, by the fact of the R having come to us from the S.E., which from the clouds having to pass over so much land had deposited their burden before reaching us.

[CARDIFF, ELY.—Our readers have, doubtless, noticed that the returns from this station frequently arrive too late for insertion, in fact have this year only been published for the months of March, April, and July. We regret to find that even of these that for July was incorrect, the return from another station, near Cardiff, having been substituted for that from Ely, which had not arrived. The amount at Ely was 7·21 in. on 18 days.—ED.]

SUPPLEMENTARY TABLE OF RAINFALL IN OCT., 1875.

[For the Counties, Divisions, Latitudes, and Longitudes of these Stations, see Met. Mag., Vol. X., p. 28.]

Station.	Total Rain.	Station.	Total Rain.
	in.		in.
Acol	2·59	Gainford	4·37
Hailsham	4·47	Shap	4·72
Strathfield Turgiss	5·85	Llanfrechfa	...
Addington Manor	6·18	Castle Malgwyn	4·66
Oxford	7·41	Heyope	7·24
Cambridge	3·07	Melrose	3·26
Sheering	3·49	Cessnock, Glasgow	5·83
Ipswich	3·51	Gruinart	6·49
Diss	3·30	Keith	3·14
Swaffham	2·58	Strathconan	4·42
Compton Bassett	7·66	Springfield, Tain	2·05
Hessary Tor, Dartmoor	10·50	Skibbereen	5·88
Teignmouth	8·69	Fermoy	7·51
Torrington	6·59	Kilrush	6·63
Trevarrick, St. Austell	9·33	Kilkenny	5·90
Taunton	7·30	Kilsallaghan	6·50
Cheadle	6·39	Twyford, Athlone	4·39
Ashby de la Zouch	5·53	Ballinasloe	3·86
Coston, Melton Mowbray	5·48	Kylemore	8·06
Bucknall	4·40	Bangor	5·39
Mansfield	5·03	Carrick on Shannon	3·93
Walton, Liverpool	4·83	Warrenpoint	7·86
Broughton-in-Furness	7·61	Bushmills	5·19
Stanley, Wakefield	3·93		

SYMONS'S
MONTHLY
METEOROLOGICAL MAGAZINE.

CXXIX.] DECEMBER, 1875. [PRICE FOURPENCE, *or 5s. per ann post free.*

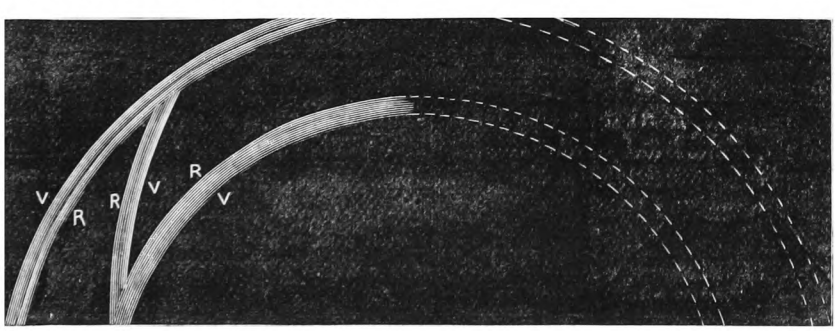
EXTRAORDINARY OR WATER-REFLECTION RAINBOW.

WE have been favoured by our esteemed correspondent, Dr. Clouston, with a description and sketch of a phenomenon, which has at present only the vague title Extraordinary Rainbow, but for which, unless a better term is proposed, we suggest that of Water-Reflection Rainbow. Dr. Clouston's note is as follows :—

On Nov. 29th, at 10.15 a.m., I observed a beautiful double iris, with an abnormal one having the same base as the primary one, and joining the secondary one about half way between its base and summit, lying across the space that separated them. It partook of the nature of a primary bow in the arrangement of its colours, having the red externally, but they were as faint as those of the secondary bow. It lasted for about 10 minutes after I observed it. This seems the place for curious rainbows; you will, perhaps, remember the one sketched by Dr. Mitchell here a few years ago. I send you a sketch of this, and will be glad if any of your correspondents can give an explanation.

CHARLES CLOUSTON.

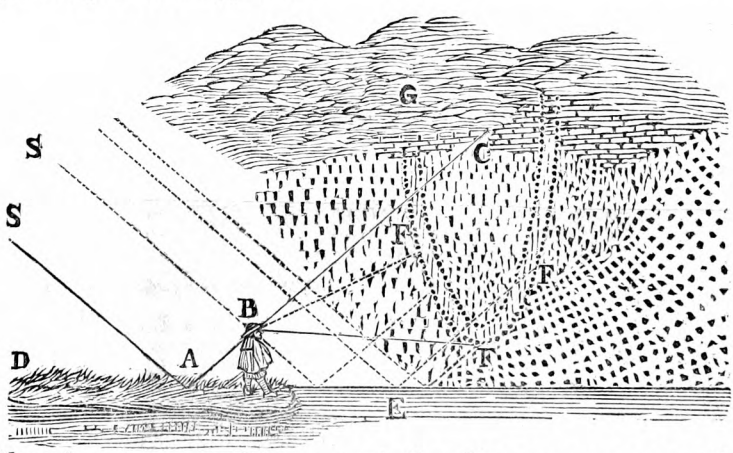
Sandwick Manse, Stromness, Orkney.



This phenomenon has been often described and explained, but, nevertheless, we believe that it is very little known, and that the majority of our readers would join Dr. Clouston in desiring an explanation. We could give this in two lines, and therewith allow the subject to drop; but as we happen to possess some rare notices of the phenomenon, we take the present opportunity of extracting and reprinting them for the benefit of our readers. The rainbow, or rather

portion of a bow, which Dr. Clouston saw, was produced by a reflected image of the sun in some body of nearly still water. The first reference which we possess to such a phenomenon is in the *Specimina Philosophiæ* of Renati Descartes. We reprint verbatim from the 4to Elzevir edition of 1677, and give the diagram in facsimile :—

"Atque ita nullam difficultatem in hac materia superesse arbitror ; nisi fortè circa illa, quæ præter ordinem assuetum naturæ in eâ contingunt. Ut quum arcus non accuratè rotundus est, aut centrum illius in rectâ lineâ Solem et oculum transeunte non jacet. Quod accidere potest vento guttarum figuram immutante : nunquam enim tam parum à sphæricâ suâ figurâ discedere possunt, quin statim illud notabilem differentiam in angulo, sub quo colores videri debent, efficiat. Audivi etiam aliquando arcum cœlestem inversum cornibus in altum erectis apparuisse, qualem hîc repræsentatum videmus F F. Quod vix crediderim accidisse, nisi per reflexionem radiorum solarium, incurrentium in superficiem maris aut lacus alicujus. Ut si à parte cœli S S effusi, caderent in aquam D A E, et indè ad pluviam C F resilirent, oculus B videret arcum F F, cujus centrum in puncto C ; ita ut prolatâ lineâ C B usque ad A, et A S transeunte per centrum Solis, anguli S A D, et B A E æquales sint, et angulus C B F duorum et quadraginta circiter graduum. Ad hoc tamen etiam requiritur summa aëris tranquillitas, ne vel minimus ventorum flatus, aquæ E superficiem inæqualem reddat ; et fortè insuper, ut nubes quædam isti aquæ superincumbat qualis G, quæ impediat ne lumen Solis rectà ad pluviam tendens, illud quod aqua eò reflectit, supprimat atque extinguat, unde sit ut non nisi rarissimè videatur. Oculus præterea in tali situ respectu Solis et pluviæ esse potest, ut videat partem inferiorem circuli, quo integra Iris constat, non videndo superiorem ; atque ita ut illum pro Iride inversâ sumamus, etiamsi tunc non versus cœlum, sed tantummodo versus terram aut aquam respicientibus appareat."

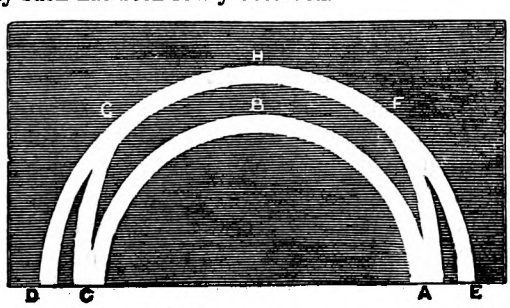


Although we can neither accept the diagram as representing a possible occurrence, nor all the reasoning of Descartes, there is no doubt that in attributing the extraordinary bow to reflection from a water surface, he gave another proof of his mental acumen.

In 1698 a water-reflection rainbow was seen by Halley, and the observation is thus reported in the *Phil. Trans.* :—

"August 6th, 1698. Between 6 and 7 o'clock in the evening, I observed an Iris, exceedingly vivid as to its colours, at first on the south side only, but in a little time with one entire arch ; and soon after, the beams of the sun being very strong, there appeared a secondary Iris, whose colours were more than ordinary

bright, but inverted, as usually, that is, the red was inwards, which in the primary Iris is outward, and *e contra* for the blues. But what I took most notice of was, that with these two concentric arches, there appeared a third arch, near upon as bright as the secondary Iris, but coloured in the order of the primary, which took its rise from the intersection of the horizon and primary Iris, and went across the space between the two, and intersected the secondary, as in the figure C G A F intersects the secondary Iris D G H F E, dividing the arch D E into three equal parts, as near as I could then guess. But at first the arch C G did not appear, which afterwards became as bright as the former. I observed the points G and F to arise, and the arch G F gradually to contract, till at length the two arches, G F and G H F, became coincident, when, for a great space, the secondary Iris lost its colours, and appeared like a white arch at the top. I observed, also, that at the points G and F, the intersection of the interior red of the secondary Iris, and the exterior red of the arch was much more intensely red than the outward limb of the primary Iris, and that during the whole appearance the upper part of the third Iris was not at all visible beyond the intersections G F. This uncommon sight entertained me for about twenty minutes, when the clouds blowing away the whole vanished. I was at first amazed with the sight, but afterwards, recollecting that the sun shone along the River Dee, which from thence empties itself into the W.N.W. where the sun then was, I concluded this secondary arch, C G H F A, was produced by the beams of the sun reflected from that water, which at that time was very calm; and it had been much more bright had it been at that time about high, as it was low water, when all the sands were bare. I was soon confirmed that my supposition was right, and that it answered all the appearance without any scruple, and that the arch C G H F A was no other than that part of the circle of the Iris, that would have been under the earth, bent upwards by reflection. I remember not to have read of any such Iris in any author. Descartes indeed speaks of an inverted Iris by reflection, but it is not possible to be seen as he describes it, and I query whether ever any such has been really observed."



On Nov. 14th, 1826, a similar bow was seen from the Soe House, near Belfast, by the Rev. Dr. Mant, M.R.I.A., Lord Bishop of Down and Connor, and fully described, with a coloured engraving, in the Trans. Roy. Irish Academy, vol. xv. The water surface in this case was probably Belfast Lough.

The following are more recent notices of the phenomena :—

"If the image of the sun is reflected by a surface of quiet water toward a cloud, this image may, in like manner, produce a rainbow, as in this case, two suns, one of which is as much below the horizon as the other is above, project their rays towards the cloud. The two bows will always meet, so that the angle between the refracted and the incident ray is 41°. The two bows will therefore cut each other, but the point of intersection depends on the height of the sun. Four bows are thus frequently seen, because the sun and also its reflected image each produces a second bow."—*Kaemtz's Meteorology*, by C. V. Walker; 1845, p. 443.

"Should circumstances be favourable, such as the presence of a sheet of water

whose surface reflects the sun's rays upon the cloud, then we shall have formed other rainbows, arising in the same manner as the primary and secondary arcs, the reflected beams being the exciting cause. These will intersect, in a point depending upon the sun's altitudes those produced directly. This phenomenon has been described as seen at Chartres on Aug. 10th, 1665, and from the walls of Chester, by Dr. Halley, Aug. 6, 1698."—*Introduction to Meteorology*, by D. P. Thomson, M.D. ; 1849. p. 222.

"EXTRAORDINARY BOWS.—When the light of the sun is reflected from the surface of tranquil water, rainbows of singular form are at times observed. On the 6th of August, 1698, Dr. Halley beheld, while walking on the walls of Chester, by the river Dee, a rainbow of the form represented in fig. 24, where C B A is the primary bow, D H E the secondary, and C G H F A the extraordinary bow, cutting the secondary at G and F ; its colours were arranged like those of the primary. The sun was shining clearly upon the calm surface of the river, and Dr. Halley discovered that the extraordinary bow was nothing more than the rest of the circle of which the primary was a part bent upwards by reflection from the water. A similar rainbow formed by reflection from the river Eure was beheld at Chartres, in 1665, where a faint arch was seen crossing the primary at its summit." —*Elements of Meteorology*, by J. Brocklesby, 1849, p. 175.

In treating of the Optical Phenomena of the Atmosphere, Professor Bravais has few, if any, equals. We are not aware that he has written any Memoir on Rainbows, analogous to his splendid work on Halos,* but in the *Annuaire Météorologique de la France*, pour 1849, p. 311, there is an interesting " Notice sur l'arc-en-ciel," from which we translate the portion bearing on our present subject :—

" One of the most remarkable varieties of rainbow is that produced by the reflected image of the sun. When a sheet of perfectly calm water reflects (répercute) the sun's rays, and directs them upon a cloud suitably situated for the production of a rainbow, it will form another arc of the first order, of 42° radius, whereof the centre will be as much below the horizon as the sun is above it. The culminating point of this reflection-arc will therefore be separated from the summit of the direct arc by an angular distance equal to twice the height of the sun above the horizon. If the sun be high, and the sheet of water extensive, it is evident that the reflection-arc may cut both the primary and secondary direct arcs. It was this form which Outhier saw, July 27th, 1736, during his voyage in Lapland, and which Celsius saw in 1743, the reflecting surface being in the first instance a lake, and in the second it was furnished by ' le Dala-Elf.' If the altitude of the sun be only a few degrees, the reflection arc lies between the primary and secondary bows, as in an observation by Senguerd, and in that of Wartmann, at Lausanne, in 1846. Halley, at Chester, saw the summit of the reflection-arc touch the secondary bow. Brandes cites other examples seen by Shulz, Sturges, Playfair, and others.

" If the sheet of reflecting water be small, the reflection arc ought to be very incomplete, and to present the appearance of a simple luminous fragment, more or less elevated above the two other arcs. This form was seen in Paris in April, 1847, and considering the position of the observers, I have no doubt that the fragment of an arc seen at an

* *Mémoire sur les Halos et les phénomènes optiques qui les accompagnent. Journal de l'Ecole Polytechnique Tome* xviii. Paris, 1847 ; 4to.

altitude of about 70°, was due to the reflection of the solar rays from the large basins near the Panthéon, which act as reservoirs for the water from the wells at Grenelle.

"If the sun be near the horizon, and the water surface slightly agitated, the reflection arc takes a remarkable form—its upper part disappears, and the lateral portions alone remain visible as vertical columns tangential to the right and left extremities of the ordinary bow; the reflection-arc is the exterior of a series of a series of first order arcs which have their centre in the sun's vertical; these arcs are almost superposed near the horizon, but separate nearer their culmination; and the diminution of light resulting from this separation of the several arcs prevents their visibility in that part of the sky.

"This is the form which Bowman saw soon after sunrise (B.A. Report, 1840). Playfair and Brandes have similarly only seen the lateral portions of reflection-arcs; they were tangents to the ordinary arc for 7° or 8°; the altitude of the sun was only 2°.

"A single occurrence cannot be explained in the foregoing manner—namely, the observation made by Canon Etienne, at Chartres, August 10th, 1665, with the sun at an altitude of 6° The centre of the extra ordinary arc was not in the solar vertical, and the arc appeared to be a portion of a great circle; it cut the ordinary arc obliquely near its point of culmination (*Journal des Savants*, 1666). I can render no perfectly satisfactory explanation of this very singular arrangement."

The reference to the subject in *Meteorologie*, von C. S. Cornelius, Halle, 1863, p. 503, is not very precise; freely translated it amounts to this:—

"It may be well here to mention that occasionally double, intersecting or even reversed (umgekehrte) rainbows have been observed. That is to say, as in the above described manner a bow may occur on a raincloud, so under certain circumstances it may happen that by the reflection of the sun's rays from a surface of still water, a second rainbow may be produced, having a different central point and in a certain manner intersecting the first bow; in other words, the image of the sun, which to a certain extent takes the place of another sun below the horizon, produces another bow differing from the first bow in position only."

"When the sun is reflected from the surface of still water, *extraordinary bows* are sometimes formed. From the reflected image of the sun being in effect beneath the horizon, such bows are larger than a semicircle. The arrangement of the colours is the same as the primary bow; and when their summit happens to coincide with that of the secondary bow, a band of white light is formed at the place of union, where they blend together."—*Handy Book of Meteorology*, by ... Buchan, 1868. p. 317.

"One of the most singular rainbows on record was that seen by Dr. Halley from the walls of Chester. C B A and D H E were the primary and secondary rainbows as seen under ordinary circumstances. Between these was another arch, C G H F A rising from the intersection of the horizon with the primary rainbow, and in its upper part dividing the secondary bow into three nearly equal parts. This intermediate arch was coloured in the same way as the primary rainbow; but during the progress of the phenomenon, Halley saw the points G F rise, and the ... F

gradually contract till the portions of the two bows between those points were identified. The intermediate and secondary bows having their colours contrary, produced, therefore, white between the points G and F ."—*Meteorology*, by G. Harvey, F.R.S., *Ency. Metrop.* London, 1848; 4to. p. *171.

Although there is some tautology in the shorter of the above notes, we think that a less evil than it would be to leave the collection imperfect, and slightly different details will be found in every one.

UNIFORMITY OF OBSERVATION HOURS.

To the Editor of the Meteorological Magazine.

SIR,—It is only now that I have remarked in your journal the review of the 9th and 10th volumes of the Meteorological Annals of our Central Institute.

I am sorry to find that you find fault with our publications because we did not lay enough stress on the uniformity of hours for observation.

I think you are aware of the fact that in Austria we have throughout unpaid volunteer observers. The difficulty of bringing them to adopt the same hours for observation is very great, almost insuperable for an Institute like ours, which has no controlling power (in the English sense of the word), but has to confine itself to entreaties which the observers are perfectly free to follow or not.* There are large climatic differences in our system of meteorological stations, and according to them, different ways of living among the various races which form the population of the Austrian Empire.

You know, perhaps, that after the recommendation of the Mannheim Society in the past century, and after the example set by Dove, the combinations 6^h 2^h 10^h had been recommended to the observers when the Vienna Central Institute was founded (23rd July, 1851).

But we found it impossible to induce observers in the southern provinces to adopt as early an hour as 6^h. In Carinthia we found an already existing system of meteorological stations carried on by the late Director J. Prettner, and employing the hours 7^h 2^h 9^h, recommended also by Humboldt as giving a very good mean daily temperature, by using the formula $\frac{1}{4}[(7) + 2(2) + (9)]$.

You know that there exists a great division in meteorological work between observations to be used for researches on the general laws of the atmospheric disturbances, or in a more general way, for International Meteorology, and those observations to be used for climatological studies.

For this latter branch of meteorology the Congress at Vienna did not exact uniformity of hours of observation. The men assembled at Vienna, knowing the difficulties inherent in any organization based

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* Of course I would prefer to have a staff of skilled and paid observers, and receive some £50,000 from the Government as General Myer does.

on unpaid volunteer action, thought it better to receive observations made at different hours than no observations at all. Then if we arrived for one country, Austria, at a uniformity of hours of observations, do you think the observers in England, France, and Italy would be induced to accept the same? and if not, do you think it a measure of first importance to establish uniform hours for Austria only, different from those in England, France, Italy, &c.?

We must advance gradually to the desired unity. For the moment I think we can be content to use the liberty left by the Vienna Congress, of choosing between different combinations. But may I, at the same time, draw your attention to the fact that the Congress has recommended that in every existing system of Meteorological Observations, researches should be made what corrections are to be applied to the daily means of the observations for obtaining *true means*, that is, according with means obtained by registering instruments, or taken every hour in 24. The Congress said further, "It is desirable to reduce the monthly means of temperature (as obtained by taking simply the sum and dividing it by the number of observations) to *true means*, and to *publish them likewise*."

Now, you find the corrections alluded to developed in a memoir published by the Academy of Vienna* and the table of corrections, corrected and enlarged, has been reprinted in the "Meteorological Annals of the Austrian Empire," vol. III., pp. 24—30.

Still more is done. Every volume of the Jahrbucher (and consequently also the Vol. IX. and X.), contains besides the plain means, the true means of temperature, or 24-hourly means. These are strictly comparable with any means obtained in England, France, and Italy, if in these countries as in Austria the pains were taken to reduce the plain means to 24-hourly, as the Meteorological Congress recommended.

As I value very highly your Magazine, and as I am desirous that a somewhat erroneous impression should not be left on the mind of the British Meteorological world, I should be obliged if you would have the kindness to publish these remarks on the Review (in Sept., 1875, p. 127), in your journal.—Yours truly,

DR. CH. JELINECK.

Hohe Warte bei Wien.

While we feel honoured by the above communication from one of the most able meteorologists of the present day, we are unable, in the slighest degree, to modify the opinions expressed in the Review. We admit all Dr. Jelineck's arguments, but our conviction that it is desirable that he should aim at greater uniformity remains unaltered,

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* "On the Diurnal Variations of Temperature, according to the Observations at the Stations in Austria. Memoirs of the Academy of Vienna."—Vol. XXVII.

and our experience with an unpaid staff of observers ten times as numerous as his, leads us to believe that he under estimates the control which he possesses over his observers, and over estimates the difficulty of reducing them to strict uniformity.

It may, however, be thought that we deal only with generalities, we are quite ready to enter into details. The first preliminary step to the examination which we made was to plot upon the map the observing-hours at each station. It would cost £10 or £20 to put this map before our readers, we can, therefore, only select a few cases where apparently little difficulty could arise in advancing towards the period when, as we said in the review, "we shall see the nineteen varieties reduced to two or three."

The following are the facts of the case, as to the number of stations employing each combination of hours—

Stations.	Hours.	Stations.	Hours.	Stations.	Hours.
1 ...	5 12 7	1 ...	6 2 8	4 ...	7 2 8
2 ...	5 12 8	18 ...	6 2 9	58 ...	7 2 9
1 ...	6 12 6	28 ...	6 2 10	11 ...	7 2 10
1 ...	6 12 7	1 ...	$6\frac{3}{4}$ $1\frac{1}{2}$ 8	1 ...	8 1 9
1 ...	6 12 8	1 ...	7 12 7	1 ...	8 2 8
1 ...	6 12 9	1 ...	7 12 10	1 ...	8 2 10
1 ...	6 1 8	5 ...	7 2 7	10 ...	not stated.

The large proportion (40 per cent.) of the Austrian observers adopting 7 a.m., 2 p.m., and 9 p.m. (hereinafter for brevity's sake we shall merely give the numerals) renders it evident that of the above-mentioned "two or three" 7, 2, 9, must be one. There is another argument for the combination 7, 2, 9, in the fact of 7 a.m. being the time of the Austrian (and also other nations') observations for weather telegraphy, consequently all stations observing at 7, 2, 9 would be available for International or chartographic meteorology on special occasions when the ordinary telegraphic reports require supplementing.

Assuming then that 7, 2, 9 be adopted, and rejecting from consideration the ten stations at which the hours are not stated, the table shows that there are already 58 stations observing at those hours, and 29 other stations at which the change of only one hour at one of their three observation-hours would bring them also into uniformity, viz., 18 to change from 6, 2, 9, to 7, 2, 9, and 11 to change from 7, 2, 10, to 7, 2, 9. To these might surely be added the 28 observing at 6, 2, 10, which by shortening their day an hour at each end would swell the band of 7, 2, 9, to 115 out 139; the remaining 24 stations will be seen by the table to have scarcely anything in common, and, therefore, as we said in the Review we think that they should be printed separately.

It is scarcely for us to discuss the changes desirable at individual stations, but among the most obvious we may mention Lesina from 7, 2, 10, to 7, 2, 9; St. Paul, in Kärnthen, from 6, 2, 9, to 7, 2, 9; Bludenz, from 6, 2, 10, to 6, 2, 9, or better still to 7, 2, 9, if the adjacent stations could also be induced to adopt the latter.

THE LAW OF STORMS.

To the Editor of the Meteorological Magazine.

SIR,—The Essay of M. Faye on "The Law of Storms" scarcely merits criticism, but as its publication in the Annuaire of the Bureau des Longitudes, and that of a lengthy abstract in the pages of such a journal as "Nature," may seem to indicate a retrograde tendency in a branch of science which is highly progressive, it is worth while to call attention to one or two points contained in it.

I.—The analogy between waterspouts and cyclones is sufficiently antiquated, and so much stress has been laid on it (unfortunately, as I think,) by Milne Home, Reye, and other "theorists of aspiration," that these cannot complain if it is now employed by an opponent. But if that analogy were more complete than it is, it would be none the less unscientific to argue *ab ignoto ad notum*, from phenomena on a small scale which are not capable of minute investigation, to others on a large, the conditions of which easily admit of almost complete examination. In a cyclonic storm the changes of pressure, temperature, the elastic force of vapour, the value of gradients, the direction and force of surface winds, and of upper-currents, their inclination to and from the isobars, &c., are readily observed and analysed. But we have no "intelligent demons" resident in the circumference and interior of a waterspout, and provided with suitable instruments for the registration of the phenomena supposed to be analogous.

II.—The incurvation of surface-winds towards centres of barometric depression, and their efflux from areas of elevation is *a most certain fact*, which any one who has constructed, or even inspected, faithful daily weather charts for one month, may be safely challenged to deny.

III.—The fact that, at a considerable elevation from the earth's surface, the currents commonly make such an angle with the surface-wind as to flow somewhat out of the areas of depression is perfectly well known to every observer who has for a very limited period compared the direction of the cloud-drift with that of the surface-wind.

IV.—The fact that the direction taken by a depression is *not* dependent upon that of its upper-currents, but that on the contrary the disposition of the upper-currents *is* dependent on the position of neighbouring depressions is also familiar to every cirrus observer.

V.—The influence on the barometer (an instrument, by the way, which is dismissed with much brevity by M. Faye, naturally enough) of the dynamical as distinct from the statical conditions of atmospheric pressure, forms a subject which certainly needs, and which is receiving, investigation. But it is practically necessary, on M. Faye's theory, to regard the barometer as influenced by the dynamical condition *alone*, a conception which will scarcely be entertained by any meteorologist of the present day.

That the theorist of the study—a study whose shelves would appear to contain hardly any meteorological work published since 1850—

should ignore the labours, both observational and theoretical, of investigators such as Buchan, Mohn, Meldrum, and Hildebrandsson is, perhaps, natural; but that he should dismiss their results as those of mere theorists, the "victims of hypothesis and old prejudice," as exploded dogmas—exploded by the *ipse dixit* of M. Faye—is surprising in anything claiming to be a scientific treatise.

All honour to our earlier cyclonologists, Redfield and Reid, who would be the first to acknowledge the importance of those modifications which subsequent research has shown to be necessary to their theories. But another retrogression similar to M. Faye's will easily carry us back to the grotto of Æolus, the earliest enunciator, so far as I am aware, of the "Law of Storms."—Yours faithfully,

W. CLEMENT LEY.

Lutterworth, Dec. 7th, 1875.

THE WINTER OF 1875-6.

To the Editor of the Meteorological Magazine.

SIR,—In your magazine for April, 1874, I stated a law showing that "when the total (mean) rainfall of April, May, July, and August, at about 40 or 50 stations, is less than 10·60 inches, but above 8·60 inches, the following winter is partly very severe." This year the total (mean) rainfall of the aforesaid four months was 10·80 inches, which is a little above the average I gave. The longer average of 30 years, however, is 11·2 inches. Compared with this, the four months referred to (of this year) were drier than usual, and as February, March, and April last appear to have been drier over the whole country than any other corresponding period on record, the coming winter should be a very severe one.—Yours obediently,

GEORGE D. BRUMHAM.

Barnsbury, Nov. 29th, 1875.

MOVEMENTS OF CIRRUS.

To the Editor of the Meteorological Magazine.

SIR,—I have a collection of 2,480 observations of the movements of Cirrus, made in the last ten years in the counties of Hereford, Derby and Leicester. The directions were as follows :—

N.	101.	S.	104.
N.N.W.	231.	S.S.E.	64.
N.W.	282.	S.E.	52.
W.N.W.	327.	E.S.E.	25.
W.	361.	E.	22.
W.S.W.	356.	E.N.E.	15.
S.W.	264.	N.E.	26.
S.S.W.	185.	N.N.E.	65.

There is one important particular in which the above figures do not speak for themselves, but require to be supplemented by a modifying remark. I believe that the number of observed upper-currents from E. and N.E. points is unduly low, as compared with the unobserved. I am led to this conclusion simply from the following fact:—Periods of many days' duration every now and then occur in which Cirrus is *very rarely visible;* and when in the course of these periods an observation can be taken, the upper-current is very frequently found to be from an easterly point. As an instance, I may mention a period which has just reached its conclusion—that extending from November 18th to the 10th of the present month. Of these 23 days Cirri were visible on six only, or a little more than a third of what should be the average number. And on each of those six days the movement was from an easterly point. The paucity, it may be remarked, of observations in those periods is due, not so much to the frequently overcast state of the sky, as to the absence of Cirrus when the sky is not overcast.

It is worthy of note that of the N. and N.W. upper-currents a very large proportion have been contributed by the early spring months, that the South-westerlies were most common in mid-winter and mid-summer, and that the Southerlies were more prevalent in the beginning of autumn, than at any other time. The years examined differed, however, a good deal in these respects. There was also considerable difference in the mean flow of the upper-currents in the different years, though hardly so much as I should have anticipated. Of the series, 1868 and 1875 were perhaps the most remarkable, from the unusual frequency of northerly upper-currents in the former, and of south-easterly in the latter, in the summer months. The maximum frequency of southerlies and south-westerlies occurred in 1872.

Are such conclusions as may be drawn from the above figures likely to be applicable to other districts besides that in which the observations were taken? I have not sufficent data from which to answer this question fully. But I may say that, judging from a very limited number of observations, the mean directions of upper-currents over France and Germany do not seem to differ much from our own; but that in Scandinavia the further we proceed to the north the more do upper-currents from northerly points appear to predominate. Dr. Hildebrandsson has called my attention to the frequency of northerly upper-currents over the north of the Gulf of Bothnia, and out of 183 observations taken by Dr. Waldenström at Umea, in the first ten months of this year, I find that Cirrus travelled in 133 instances from N.E., N., or N.W. points.—I am, Sir, yours truly,

W. CLEMENT LEY.

Ashby Parva, Lutterworth, Dec. 14th, 1875.

BOOKS RECEIVED.

AUSTRIA.

HANN, DR. J. Untersuchungen über die Veränderlichkeit der Tagestemperatur. [Aus dem LXXI. Bande der Sitzb. der K. Akad. der Wissenchaften II Abth. April, 1875.] 8vo.

Zeitschrift der Österreichischen Gesellschaft für Meteorologie, 15 September–1 October, 1875. 8vo.

CANADA.

Abstracts and Results of Magnetical and Meteorological Observations at the Magnetic Observatory, Toronto, from 1841 to 1871, inclusive. 8vo. 1875.

Reports on the Meteorological, Magnetic and other Observatories of the Dominion of Canada, for the year ending December 31st, 1874. 8vo. 1875.

CAPE OF GOOD HOPE.

DYER, J. E., M.D. Meteorological Register at Kimberley, July, 1875.

DENMARK.

Bulletin Météorologique du Nord publie par les Instituts météorologiques de Norvége de Danemark et de Suède. Oblong 4to.

Meteorologisk Aarbog for 1873, udgivet af det danske Meteorologiske Institut, 1875. Oblong 4to.

FRANCE.

MARCHAND, EUGENE. Etude sur la Force Chimique contenue dans la Lumière du Soleil. 8vo.

MARIE-DAVY, M. Bulletin Mensuel de l'Observatoire de Montsouris, Juin et Juillet, 1874. 4to.

GREAT BRITAIN.

DUNLOP, W. H. Weather Statistics during the Small-pox Epidemic in Kilmarnock of 1873–74. Large 8vo.

FOX, CORNELIUS B., M.D., M.R.C.P. Water Analysis : As it should, and as it should not, be performed by the Medical Officer of Health. Second Edition, small 8vo, 1875.

HENNESSY, H., F.R.S., M.R.I.A. On an Inverted Lunar Halo and a Lunar Rainbow. (From the Proceedings of the Royal Irish Academy), 8vo.

LEICESTER. Report of the Council of the Leicester Literary and Philosophical Society, 1874–75. 8vo.

LEICESTER. Third Report of the Museum Committee to the Town Council. 8vo. 1875.

METEOROLOGICAL COMMITTEE. Instructions in the Use of Meteorological Instruments. Large 8vo, 1875.

METEOROLOGICAL COMMITTEE. Quarterly Weather Reports of the Meteorological Office, October–December, 1873, January–March, 1874. 4to, 1875.

MILLER, S. H., F.R.A.S., F.M.S. The Fenland Meteorological Circular and Weather Report, August, 1875. 4to.

REPORT of the Meteorological Committee of the Royal Society for the year ending 31st December, 1874. Large 8vo, 1875.

SOBRAON GOSSIP. Extracts from a Weekly Newspaper published on board the "Sobraon" during her passage from Melbourne to London. 8vo, 1875.
STANFORD'S Orographical Map of the British Isles.

UNITED STATES.

HINRICHS, DR. GUSTAVUS. Monthly Results of the Meteorological Observations at the Laboratory of the Iowa State University at Iowa City, Iowa, January to August, 1875.
HINRICHS, DR. GUSTAVUS. Preliminary Note on the Iowa County Meteorites. Single sheet 4to.
HINRICHS, DR. GUSTAVUS. The Great Iowa Meteor (reprinted from the Popular Science Monthly, September, 1875). 8vo, 1875.

SUPPLEMENTARY TABLE OF RAINFALL IN NOV., 1875.

[For the Counties, Divisions, Latitudes, and Longitudes of these Stations, see Met. Mag., Vol. X., p. 28.]

Station.	Total Rain.	Station.	Total Rain.
	in.		in.
Acol	5·38	Gainford	5·79
Hailsham	5·71	Shap	3·84
Strathfield Turgiss	3·41	Llanfrechfa	8·90
Addington Manor	4·32	Castle Malgwyn	6·28
Oxford	3·80	Heyope	...
Cambridge	3·66	Melrose	4·35
Sheering	3·78	Cessnock, Glasgow	4·43
Ipswich	4·65	Gruinart	5·40
Diss	5·06	Keith	4·37
Swaffham	5·55	Strathconan	4·33
Compton Bassett	4·02	Springfield, Tain	2·95
Hessary Tor, Dartmoor	9·26	Skibbereen	4·88
Teignmouth	5·81	Fermoy	5·48
Torrington	8·21	Kilrush	2·93
Trevarrick, St. Austell	7·96	Kilkenny	2·52
Taunton	4·64	Kilsallaghan	5·15
Cheadle	4·17	Twyford, Athlone	3·75
Ashby de la Zouch	4·23	Ballinasloe	...
Coston, Melton Mowbray	4·23	Kylemore	5·99
Bucknall	5·08	Bangor	5·11
Mansfield	3·99	Carrick on Shannon	4·30
Walton, Liverpool	3·12	Warrenpoint	5·87
Broughton-in-Furness	7·41	Bushmills	4·74
Stanley, Wakefield	3·48		

NOVEMBER, 1875.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1860–5	Greatest Fall in 24 hours. Dpth	Date	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Max. Date.	Min. Deg.	Min. Date.	No. of Nights below 32° In shade	On grass
			inches	inches.	in.								
I.	ENGLAND.	Camden Town	3·36	+ ·95	·67	10	20	58·8	18	25·6	27†	3	11
II.		Maidstone (Linton Park)	4·39	+ 1·20	·87	8	23	58·0	18	28·0	26‡	2	...
,,		Selborne (The Wakes)	4·73	+ 1·19	·73	10	17	57·0	4	25·0	27	6	12
III.		Hitchen	4·16	+ 2·02	·81	10	21	54·0	4	24·0	30	10	...
,,		Banbury	4·84	+ 2·64	1·12	13	23	56·0	18	26·0	26	10	..
IV.		Bury St. Edmunds (Culford)	5·26	+ 2·87	·89	10	19	58·0	18	25·0	25	7	17
V.		Bridport	4·75	+ 1·59	·95	7	16	63·0	4	23·0	27	10	...
,,		Barnstaple	7·15	+ 3·01	1·47	13	20	64·0	4	26·0	27	..	...
,,		Bodmin	7·12	+ 2·14	1·07	12	19	60·0	3	26·0	27	5	12
VI.		Cirencester	5·04	+ 2·25	1·12	13	14	....	...	...	...	...	...
,,		Shifnal (Haughton Hall)	3·56	+ 1·99	·64	9	16	57·0	18	26·0	9	10	17
,,		Tenbury (Orleton)	4·04	+ 1·57	·76	13	24	62·0	4	27·0	9	5	14
VII.		Leicester (Belmont Villas)	3·61	+ 1·43	·80	13	23	59·2	18	29·8	9	4	..
,,		Boston	4·90	+ 2·76	·93	13	25	57·0	4, 18	30·0	9,26	5	...
,,		Grimsby (Killingholme)	5·82	...	·76	13	24	56·0	4*	31·0	9‖	4	...
VIII.		Manchester	...	...	...	...	...	...	...	...	...	...	...
IX.		York	...	...	...	...	..	...	...	...	..	..	..
,,		Skipton (Arncliffe)	7·66	+ 1·21	1·80	13	24	50·0	17	24·0	13	16	...
X.		North Shields	5·81	+ 3·11	1·53	13	23	56·6	5	30·3	9	4	13
,,		Borrowdale (Seathwaite)	12·10	— 4·57	2·15	18	14	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely)	8·24	+ 4·00	1·67	13	17	...	...	...	...	...	...
,,		Haverfordwest	7·61	+ 1·94	1·17	13	20	58·0	4	23·0	26	5	12
,,		Rhayader (Cefnfaes)	...	...	..	...	...	...	...	...	...	...	...
,,		Llandudno	4·25	+ 1·09	1·08	13	16	61·1	3	32·8	27	...	...
XII.	SCOTLAND.	Dumfries (Crichton Asylum)	3·94	+ ·68	·98	2	11	58·4	5	23·8	10	10	18
,,		Hawick (Silverbut Hall)	3·71	...	·85	13	21	...	...	...	...	...	...
XIV.		Kilmarnock (Annanhill)	3·96	...	1·04	2	16	58·4	4	22·7	11	16	17
XV.		Castle Toward	...	...	...	...	...	...	...	...	...	...	..
XVI.		Leven (Nookton)	4·51	+ 1·47	·56	13	21	57·0	4,5	21·0	11	11	20
,,		Stirling (Deanston)	...	...	...	...	...	..	...	...	...	...	...
,,		Grandtully	3·15	...	·50	13	11	...	...	..	...	..	...
XVII.		Braemar	4·07	+ 1·25	·86	13	20	53·8	4	10·0	10	19	24
,,		Aberdeen	3·95	...	·46	7	25	59·2	4	22·1	11	7	19
XVIII		Loch Broom	4·77	...	·56	15	15	...	...	...	...	...	...
,,		Portree	7·15	— 3·33	1·71	18	18	...	...	...	...	...	...
,,		Inverness (Culloden)	3·09	+ ·50	1·08	8	17	57·3	3	23·1	27	14	24
XIX.		Helmsdale	4·68	...	·73	6	24	...	...	...	...	...	...
,,		Sandwick	4·05	+ ·05	·92	18	21	52·9	4	28·0	28	7	18
XX.	IRELAND.	Caherciveen Darrynane Abbey	4·37	...	·78	13	15	...	...	...	...	...	...
,,		Cork	4·21	...	1·00	3	15	...	...	...	...	...	...
,,		Waterford	4·44	+ ·49	·80	2	20	61·0	5	29·0	27	6	...
,,		Killaloe	4·42	— ·47	·78	13	15	60·0	2	26·5	22	...	...
XXI.		Portarlington	3·11	— ·81	·97	14	22	59·0	2	27·0	26	12	...
,,		Monkstown, Dublin	3·98	+ 1·09	1·09	13	18	...	...	...	...	...	...
XXII.		Galway	2·84	...	·82	1	14	59·0	2,5	25·0	27	10	...
,,		Ballyshannon	3·66	...	·55	13	15	...	..	...	...	...	...
XXIII		Waringstown	3·55	...	1·19	13	20	61·0	3	23·0	8	17	21
,,		Edenfel (Omagh)	4·10	...	1·05	13	15	57·0	2	21·0	10	19	...

* And 17 & 18. † 30. ‡ 27. ‖ 10, 26 & 27.

+Shows that the fall was above the average; —that it was below it.

METEOROLOGICAL NOTES ON NOVEMBER.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; TS for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

LINTON.—First twenty days mild, dull and wet, with high winds on the 6th and 14th; afterwards it was much colder, the last week wintry, with S every day, and the ground slightly covered all the time. The winds very changeable in the early part of the month, but settled into the N. towards the end; the nights often very dark. Altogether it may be pronounced a wet month, and early beginning of winter.

SELBORNE.—An unusually wet November; autumn wheat sowing seriously interfered with. Prevailing winds more or less S. or S.W. to the 14th, then W. for a few days, and the last ten days N. and N.E.. Bar. remarkably low throughout; ther. at the freezing point on the 1st, the first time since April 26th; [max temp. of the 30th only 31°.

BANBURY.—Floods on 7th, on 11th, and still greater on the 14th, when the water was 9 in. deep over the rail at the Great Western Railway Station, and a portion of the permanent way was much injured; on that day it was very dark at 2 p.m., and the wind high in the latter part of the day.

CULFORD.—Bar. very low about the 9th, but rose very suddenly on the 14th; high wind on 19th; S on 20th and 27th. Easterly winds prevailed on 16 days, and westerly on the remaining 14. The month remarkably free from fogs. Mean temp. 40°·9.

BRIDPORT.—Very high tide. Heavy gale of wind, and floods higher than known for years on the 6th.

HAUGHTON HALL.—This has been a wet, cold, unpleasant month, for when it did not rain, which it did daily with few exceptions till the 19th, keeping up thereby the vast saturation of October, the cold winds from N.W., N., and N.E., which accompanied the R, and followed it to the close, rendered the temp. low and trying; but there were no fogs. Frosty nights began on the 8th, and continued with a few exceptions (11th, 14th, 18th, 19th, 23rd and 24th) to the end. On the 9th the R and S amounted to ·64 in. The steadiness of the bar., from 20th to 30th inclusive, was remarkable—the range being then only from 29·64 to 29·87. Redwings first seen on 3rd; large flocks of wild geese flying from E. to W. on 25th.

ORLETON.—Very cloudy and gloomy, with a temp. generally high, and heavy falls of R till the 19th; on the 10th and 14th great floods on the river Teme. Bar. generally low till the 14th, when, at 10 a.m., it stood at 28·70, and at 9 p.m. it had risen to 29·70, an increase of 1 in. in 11 hours. On the 19th the wind became very violent, and changed to the N.W. and N. The remainder of the month very cloudy and cold, but dry. The mean temp. of the month was about half a degree above the average.

LEICESTER.—Another wet month, especially the first half. High floods on the 14th for a few hours. Mean temp. 41°·6; temp. very low during the last week, especially by day; 25·62 in. of R (nearly a year's average) have fallen since the 1st of June.

BOSTON.—The rainfall of this month (4·90 in.) is the highest on record here, the next being in 1852, when 4·32 in. fell; the fall for Sept., Oct., and Nov. of this year is 10·64 in., against an average of the preceding 20 years of 5·97 in.: this quantity was exceeded in 1852, when 11·05 in. fell. Notwithstanding this heavy fall the Fens have not suffered the severe damage experienced in other places. Owing to steam and pumps, some of the lowest land is the driest; and with the exception of a small area of low-lying land not drained by steam-power, and one or two districts where the protecting banks have given away, no damage beyond the delay in sowing the wheat has been done, although the Witham has been fuller than ever known before.

GRIMSBY.—Lunar halo on 7th and 12th. Very high tide in the Humber at night on 14th. Very wet month, and the latter part of it cold; scarcely a pleasant day from the beginning to the end. The ground thoroughly saturated, and causing apprehension with regard to the newly sown wheat.

ARNCLIFFE.—Wet, dark and cold. Rapid rise in bar., 28°·20 to 29°·83, on 15th.

NORTH SHIELDS.—L on 8th; lunar halos on 8th, 9th, 12th and 14th; high night temp. on 17th.

SEATHWAITE.—Three days on which the fall was 2 in. or more.

WALES.

HAVERFORDWEST.—The first three weeks incessant R, followed by a cold, dry, frosty period; and under the influence of the keen E. wind and the sharp frost the ground rapidly became admirably prepared for agricultural operations. Several heavy gales, and very great floods, characterized the month.

LLANDUDNO.—The beginning of the month very wet and damp; after the 18th a cold period, E. and N.E. winds, with a dull, leaden sky, and scarcely any sun. Lime divested of leaves on 2nd, chesnut on 5th, mountain-ash and sycamore on 9th, copper-beech on 13th, and hawthorn and wych-elm on the 18th. Hills covered with S from the 8th.

SCOTLAND.

DUMFRIES.—The first half of the month wet and blustering, but no violent gales or destructive floods; the latter half cold and dry, with moderate northerly winds and almost continuous frosts. Rainfall, though above the average, is 1·70 in. lower than November of last year. Mean temp. 40°, being 2° lower than last November.

HAWICK.—First S shower on the 7th; ground covered with S to the depth of 4 inches from the 23rd to the close. Hurricanes on 13th and 19th; winds easterly from 13th to 30th. The frost has not been severe during any night of the month.

ANNANHILL.—Aurora and L on evening of 9th; S on 9th, 25th, 26th, and 30th; gale, E.N.E., on 13th, velocity 56 miles an hour.

NOOKTON.—High wind at 7 p.m. on 13th.

BRAEMAR.—An unusually cold, frosty month. Potatoes and turnips, in consequence, to a good extent unsecured.

ABERBEEN.—A month of stormy, unsettled weather; winds from the N.E. and E., more frequent than the average; R above the average; bar. pressure, temp. and wind pressure below the average. L on 25th. Min. on grass 16°·7 on the 11th.

LOCHBROOM.—R on every day but the 9th to the 16th inclusive, thence to the end of the month the most intense frost ever remembered so early in the season, insomuch that an arm of the sea called the Big Loch was frozen over from side to side for miles for some days an inch thick, a circumstance never seen at this time of the year before.

PORTREE.—Heavy gale from the N. from 4 a.m. to 9 a.m. on 19th; S, H and sleet showers from 7th to 12th, and hard black frosts from 21st to the end of the month.

SANDWICK.—The first half of November was wet and boisterous, but the last nine or ten days were uncommonly fine, being dry, calm and frosty. I do not remember such a continuation of calm days as we had on the five succeeding the 21st; the anemograph marked only 12 miles on the 23rd, and 19 on the 24th. The most remarkable meteorological phenomena was the curious abnormal Iris on 29th, at 10.15 a.m., of which I enclose a sketch. [See p. 165.]

IRELAND.

DARRYNANE.—First fortnight wet and foggy, last ten days very dry and hard frost at night; gale on the night of 13-14th from W., with fearful squalls; many trees blown down and hay stacks upset. Fresh gale on 6th, and a moderate one on 28th.

BALLYSHANNON.—The first half of the month has been marked by heavy R, by which the river Erne was swollen to an unusual extent; the latter half has been free from R, and smart frost has occurred on every night. Ice on the lakes 1 in. thick; mountains covered with S.

WARINGSTOWN.—The dry weather and cold easterly wind in third week enabled the farmers to get on with wheat sowing, which had been hitherto impossible; a large breadth has been sown in the last ten days. This district has to a very great extent escaped the heavy rains, aud the fall has very little exceeded the average.

EDENFEL OMAGH.—Weather up to the 18th a continuance of the incessant wet which prevailed during October, but with a steadily decreasing temp. From the 18th to the end dry, cold and generally clear, with frost more or less every night.

SYMONS'S
MONTHLY
METEOROLOGICAL MAGAZINE.

CXXX.] JANUARY, 1876. [PRICE FOURPENCE, *or 5s. per ann. post free.*

TEMPERATURE OF THE SOIL.

AMONG the many problems of meteorology which are waiting for observation and discussion, that of the connection between the growth of plants and the temperature of the soil, may fairly claim to be one of the most interesting, and one of practical importance.

In most branches of meteorology the instrumental means of observation, and the accumulated masses of records are in advance of the mental power available for their discussion, but we do not think that that is the case with respect to earth temperature. We therefore devote the present article to a brief narrative of the arrangements proposed, and adopted, for ascertaining the temperature of the soil at slight depths.*

In the *Report of the Committee* [of the Royal Society] *of Physics, including Meteorology, on the objects of scientific inquiry in those sciences*, London, 1840, 8vo,† the only reference to this subject is as follows:—

"The temperature of the soil at different depths is a point of considerable importance. For this purpose excavations should be made in a dry sheltered situation, three, six, and nine feet deep, and lined with brick or earthenware tubes. In the bottom of these excavations earthenware quart bottles may be carefully placed, filled with water, spirit, or brine, and corked. They must be carefully covered with tow or cotton, and drawn up on the days of horary observation, and their temperatures taken by an accurate thermometer."

It is rather remarkable that in Professor Daniell's very instructive essay on climate considered with regard to horticulture,‡ delivered

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* For notes on the temperature of the earth at great depths see *Meteorological Magazine*, Vol. III., p. 174, *et seq.*

† This roundabout title should have been merely "Instructions for Magnetical and Meteorological Observations."

‡ Elements of Meteorology, by J. F. Daniell, D.C.L., F.R.S., third edition, 1845, Vol. II., p. 218.

before the Royal Horticultural Society, he has considered every part of plants except the roots, and has entirely overlooked the question of the temperature of the soil.

The Meteorological Society of Scotland have devoted some attention to the subject, and on the back of their schedules give (or rather gave in 1865) the following instructions :—

"*Underground Thermometers.* As the germination and health of crops and plants greatly depend on the temperature of the soil—its amount and constancy—the council recommend that observations in this interesting department be made at 9 a.m., by thermometers placed in the earth, their bulbs being sunk to three, twelve, and twenty-two inches [What queer intervals.—ED.]; and the stems above ground protected from the sun's rays, and fitted with sloping tin collars, to prevent rain water being conveyed to the bulbs by the stems or wooden frames. Mention must be made of the geological formation and agricultural condition of the soil in which these thermometers are placed."

M. Renou, in his *Instructions Météorologiques*, Paris 1857, 8vo., writes to the following effect :—"One may observe the temperature of the soil at various depths by means of fixed thermometers, but to observe at a depth of several metres it is necessary to construct on the spot special thermometers, and to plunge them in bore holes lined with iron so closed as to prevent circulation of air. As the temperature varies with the depth, it is necessary to correct the reading of the thermometer for the temperature of its long column. This can be done by employing the indications of other thermometers sunk to less depths, but it is both more convenient and more exact to attach to the thermometer, throughout its entire length, another precisely similar and similarly graduated tube; the difference of the two indications is the correction to be applied to the thermometer in order to take account only of the temperature of its bulb."

"It is much more convenient, especially at great depths, and for the indispensable verification of the instruments, which ought to read easily to one-hundredth of a degree (which can only be done when one degree occupies fully one-third of an inch) to sink in the bore hole a pipe of galvanized iron four inches in diameter, and to put down a thermometer attached to a piece of wood and wrapped in wool, which is easily raised in order to take the readings; a thermometer so mounted changes its reading extremely slowly; immediately after reading, it should be returned down the tube and the top closed. It is necessary to remark that a bore hole should not be used immediately after construction, for the work develops heat, which is not dissipated for some days."

Dr. Jelinek, in his *Anleitung*, 1869, p. 46, refers briefly to the method of Lamont described in the fourth supplement to the annals of Munich Observatory. A similar but rather fuller description is

given in Ebermayer's *Physikalischen Einwirkungen des Waldes*, Aschaffenburg, 1873, p. 12, whence we have copied the annexed engraving. The apparatus consists of four square tubes (like organ

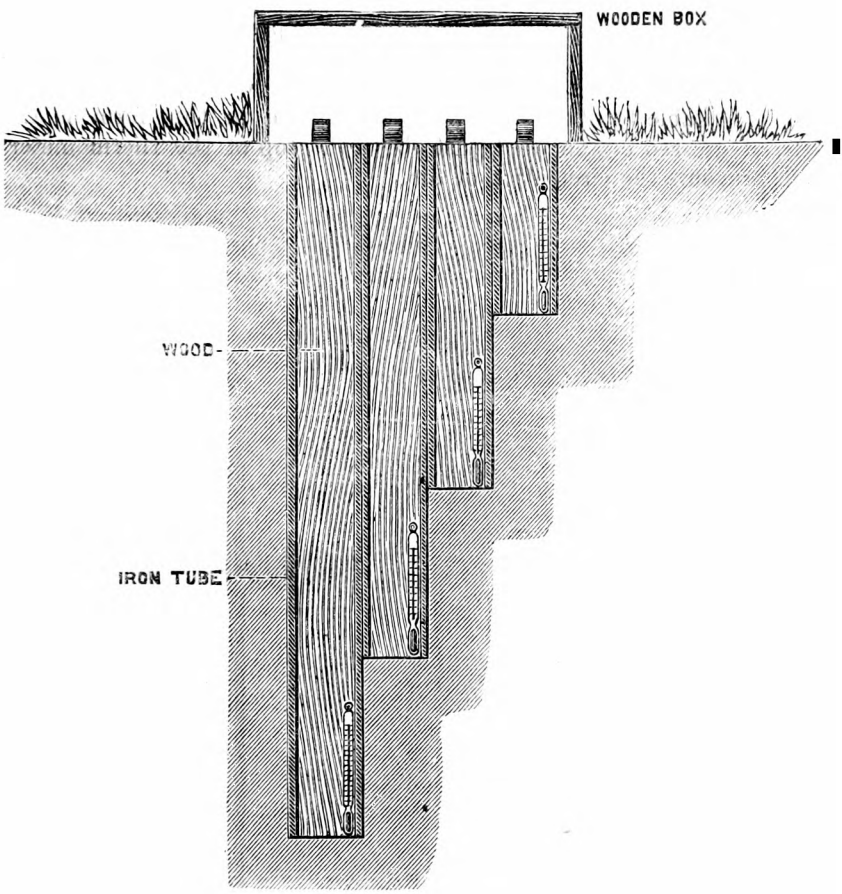

Fig. 1.

pipes), one, two, three, and four feet long, sunk vertically into the earth; fitting loosely into these are four wooden plugs, with knobs at the top and thermometers at the bottom protected by small copper plates. The box or lid over the top is of wood, and can, if desired, be hinged and locked; the thermometers are divided to 0°·1 R, and can, therefore, easily be read to 0°·01 R.

In May last, Professor Wollny, of Munich, described* a modification of Lamont's earth thermometer, designed with the object of avoid-

* Zeitschrift der Osterreichischen Gesellschaft für Meteorologie, Band X., No. 10.

ing the errors caused by the access of water to the inside of Lamont's vertical tubes. Professor Wollny's arrangement is represented in fig. 2 but the essential point is easily explained. He states, very truly, that there is no material better adapted to exclude water than glass, and he therefore makes the tube smaller than Lamont, about one and a half in., diameter, and of strong glass. Unluckily he spoils this good idea by making the bottom of the tube *not of glass*, but of metal cemented to the glass tube—a species of joint which we should not consider likely to be remarkable for durability. A good feature in this form is the collar, of greased cotton wool, just above the top of the thermometer, which prevents the circulation of air.

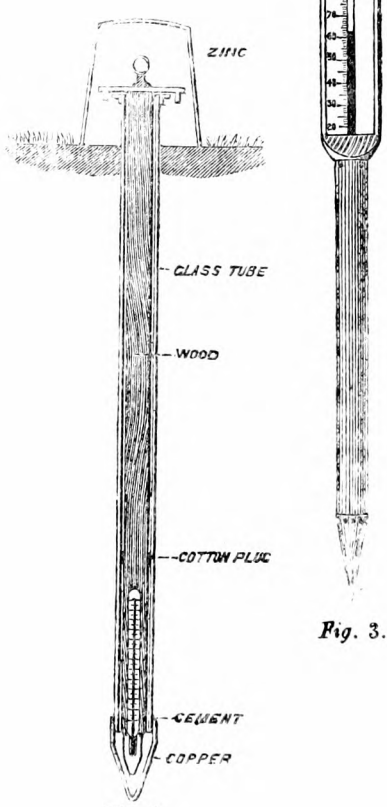

Fig. 2.

Fig. 3.

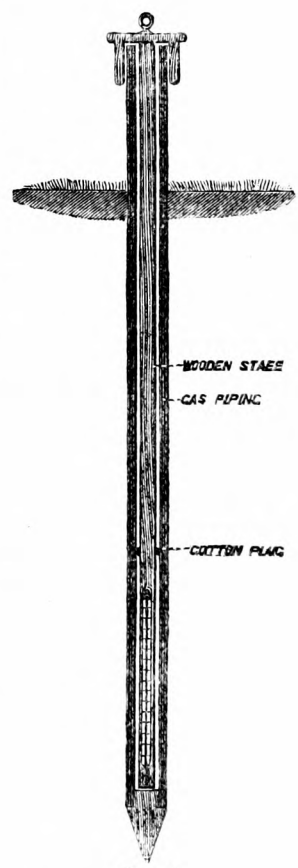

Fig. 4.

There are at present very few sets of instruments for the purpose

of determining earth temperature in use in this country, and the English instruments have not been either durable or easy to read. Fig. 3 represents the most usual form, wich is really that of a hot-bed thermometer. We have had made by Mr. Casella the instrument represented by fig. 4. The tube is very stout iron gas pipe, one inch internal diameter, the lower end closed by welded ing, so as to give great strength and absolute water-tightness; we have adopted Professor Wollny's plan of putting the oil plug and a modification of his cap, making it drop further down so as to prevent indrip. A difference will also be noticed in the mounting of the thermometer bulb, which is in Professor Wollny's surrounded by a perforated metal sheath, while in ours it is as much bedded in non-conducting materials as is possible, with the object of preventing any alteration in temperature during withdrawal and reading. It may be objected to ours that the metal of the tube will convey, to the bulb of the thermometer, temperatures other than that of the soil level with it; certainly glass would be better in that respect, and a stout glass tube, *hermetically sealed* at the bottom, might easily be substituted for our iron one, but it seems doubtful if any temperature acquired by the upper part of the tube would not be so dissipated as to be insensible long before penetrating to the depth of the thermometer bulb, and the liability of the glass to breakage is strongly against its employment.

As regards personal comfort the difference between the use of figs. 3 and fig. 4 is very great; it is very uncomfortable to have to put one's head level with the ground, yet that is the only way of reading the old patterns accurately, unless they be inclined, and if that is done then the instruments must be made longer proportionally to the angle at which they are inclined, and even then the head must be brought within a foot or two of the ground, while nothing of the kind is necessary with the new pattern, the faults of which have not yet shown themselves, though doubtless it has some.

OZONE AT 6,000 FEET ABOVE SEA LEVEL.

To the Editor of the Meteorological Magazine.

SIR,—The amount of ozone in the air at considerable elevations above sea level cannot be so frequently tested as at stations on ordinary levels where observations can be made all the year round, because they are practically uninhabitable for six or eight months of each year. For this reason it is possible that even a few trustworthy observations made at about 6,000 feet above sea level may be worth recording. Last autumn I spent a week at the Rhone Glacier Hotel, Switzerland, and tested for ozone six days consecutively. For the purpose of avoid-

ing the risk of inequality in the papers I used two in the cage each time, and exposed them for twenty-four hours carefully protected from sun and rain. The situation was well up the mountain side amid a wilderness of rocks where cattle could not influence the result by their ordure or breath. There was absolutely no source of air contamination discoverable; the nearest house, the hotel, was half-a-mile distant, the glacier rather more. The weather was faultless for the elevation and the season, no thunderstorms, no rain; the wind blew invariably up the valley towards the glacier from about 3 p.m. till night, caused by the action of a hot sun on the Furka and other mountain masses at its head; in the morning and mid-day it was moderate; direction variable.

For the striking inequality of the results I attempt no explanation; to justify any a very much longer series of observations would be necessary: the large proportion of ozone on two of the days proves that, sometimes at least, it abounds as much at high as at lower levels.

1875.						
Aug. 31	... Two papers exposed together,	24	hours,	each	...	9
Sept. 1	... ,,	,,	,,	,,	...	8
,, 2	,,	,,	,,	,,	...	4
,, 3	... ,,	,,	,,	,,	...	4
,, 4	... ,,	,,	,,	,,	...	6
,, 5	,,	,,	,,	,,	...	5

The paper was of unexceptionable quality fresh from Casella's of Holborn: the scale used was that of Negretti and Zambra.

In testing for ozone in Switzerland, even at considerable elevations and far from towns, the quantity found is sometimes surprisingly small; this I have always found could easily be explained by the existence of one or more of those filthy and reeking muck heaps abounding in most of the Swiss villages; they are a nuisance, a source of danger, and a national disgrace.

Your obedient Servant,

THOMAS PALMER, M.D.

Cahir, Co. Tipperary, Ireland.

MOVEMENTS OF CIRRUS.

To the Editor of the Meteorological Magazine.

SIR.—I do not clearly understand Mr. Clement Ley's Table of the directions of Cirrus (ante p. 174). From my own observations, many years since, as well as recently, I have been in the habit of distinguishing between the direction of Cirri and Cirro-cumuli as arranged in the sky (polarized, the term used by Humboldt) and the direction in which they move. I have found the long thread-like streaks of Cirrus

on a fine clear blue sky maintain their direction for hours, their motion being coincident with their arrangement on the sky, I have also found the motion of such bands of Cirri to be at right angles to their lines of polarization. In the latter case the bands have coalesced and the sky has become covered with a more or less uniform sheet of Cirro-Stratus, often characterized by the presence of halos. The distinction I apprehend is important, especially as for many years past Cirri have been associated with electrical conditions of the atmosphere, and still more recently with Auroræ. I am not aware if the heights of Cirri have been determined. So far as regards the magnetic affections of Cirri, Mr. Ley's table gives the greatest number of directions from W.N.W., W., and W.S.W. roughly at right angles to the magnetic meridian. Does Mr. Ley give these directions as of Cirri moving across the magnetic meridian, or do I understand that the bands were arranged (polarized) from W.N.W. to E.S.E.; W. to E.; and W.S.W. to E.N.E.? I have mostly found these clouds—Cirri and Cirro-cumuli—polarized in or near the magnetic meridian; more rarely at right angles to it.—Yours faithfully,

W. R. BIRT.

December 23, 1875.

SNOW MEASUREMENT.

To the Editor of the Meteorological Magazine.

SIR,—I beg to send you the following observations which were carefully taken during the snowy weather at the beginning of this month :—

Date.	Miles of wind in 24 hours.	Average size of flakes.	No. 1 gauge, 5 in. diameter. Depth of funnel, 5 in.	No. 2 gauge, 8 in. diameter. Depth of funnel, 6½ in.	On the ground, average depth of snow.
					in.
Dec. 2	120	large	·280	·295	4½*
,, 4	187	medium	·133	·133	2½†
,, 5	201	large	·112	·113	1½†
,, 6	238	medium	·084	·090	1†
Total	...	..	·609	·631	9½

HOW MELTED.

* Snow taken out, put into a closed vessel, and placed in a warm room.
† By pouring warm water into funnel.

No. 1 and 2 gauges are 2 feet above the ground. These totals being corrected (see page 19 "Rain: How, When, Where, Why it is Measured,") makes No. 1 gauge yield at the ground level ·655, and

No. 2, ·678 for 9½ inches of snow; this is then equivalent to a rate of 1 inch of rainfall for every 14 to 14·5 inches of snow. In your instructions in the "British Rainfall," you advise observers to take one-twelfth as the equivalent of water. I had also the following gauges, placed in a tolerably exposed position 65 feet above the ground, they gave similar results (allowing of course for difference of height, which is not added).—

No. 3 gauge, 8 in. diameter, Snowdon pattern; depth of funnel 12¾ in.; snow melted ·554 in.
No. 4 gauge, 8 in. diameter, Glaisher pattern; depth of funnel 6½ in.; snow melted ·562 in.
No. 5 gauge, 5 in. diameter (copper); depth of funnel 4¼ in.; snow melted ·550 in.

I should like to know if any similar observations have been taken lately, and if so, with what results?

Examination of Thermometers.

I am glad to see by a certificate of a fork-bulb minimum (by Casella) which I have just received from Kew Observatory, that the scale-readings are in future to be taken below 32° (for which there is no extra charge); often there is no error at the freezing point, when a few degrees lower a correction should be made, take the following index errors of the above thermometer as an example.

At 12°	+ 0·3	At 52°	— 0·0
,, 22°	+ 0·4	,, 62°	— 0·0
,, 32°	— 0·0	,, 72°	— 0·1
,, 42°	— 0·1		

Yours faithfully, KAUFMANN J. MARKS.

11, *Warrington Crescent, W., Dec. 24th*, 1875.

REVIEWS.

Abstracts and Results of Magnetical and Meteorological Observations at the Magnetic Observatory, Toronto, Canada, from 1841 to 1871 inclusive. Toronto: Copp, Clark and Co., 1875. 8vo.

Of all the British Magnetical Observatories that at Toronto has been the most successful. That it has been fortunate in its directors is at once shown by the names of Riddel, Younghusband, Lefroy, and from 1855 to the present time Kingston; the site chosen for it was a good one, the continuity of the observations has been secured, and from time to time useful results have been published. In the matter of

publication we have two complaints to make. First, it is to be regretted that the works are not uniform in size. The first three volumes, published under the superintendence of General Sabine are quarto, then we have two thin volumes published in 1864 which are small quarto, and the present book is an octavo. Our second regret is the omission of a list of the publications of the establishment (such as we are glad to see in every work issued by the Meteorological Committee); a list of this kind occupies little space, and is of great service, as showing at once what information has been published. The following queerly worded paragraph in the introduction to the present work leaves us in uncertainty as to what has been issued.

"As details regarding the several instruments and their adjustments are described at length in the three first volumes (1840 to 1848*), and in the three volumes 1853–62, they are omitted here."

In the hope that it may lead to the removal of the uncertainty now hanging over the Toronto publications, and also that other Directors may be induced to follow the example of the Meteorological Committee, we give the following list of the publications connected with Toronto Observatory, which we possess, and we hope that Prof. Kingston will enable us to perfect it in a subsequent number.

Sabine, Col. E., R.A. Observations on a Remarkable Magnetic Disturbance at Toronto, Sept. 26th, 1841 [Excerpt from British Association Report, 1841]. 1842; 4to.

Sabine, Lieut.-Col. E., R.A. Observations made at the Magnetical and Meteorological Observatory at Toronto, in Canada. Vol. I. (1840–42). London, 1845. 4to.

Sabine, Lieut.-Col. E., R.A. Report on the Meteorology of Toronto. [Excerpt from British Association Report, 1844]. London, 1845. 8vo.

Sabine, Col. E., R.A. Observations made at the Magnetical and Meteorological Observatory at Toronto, in Canada. Vol. II. (1843–45). London, 1853. 4to.

Sabine, Col. E., R.A. On the Periodic and Non-periodic Variations of the Temperature at Toronto, from 1841 to 1852 inclusive. [Excerpt from Phil. Trans., 1852]. London, 1853. 4to.

Sabine, Col. E., R.A. On the Influence of the Moon on the Magnetic declination at Toronto [Excerpt from Phil. Trans.], 1853; 4to.

Sabine, Major-Gen. E., R.A. Observations made at the Magnetical and Meteorological Observatory at Toronto, in Canada. Vol. III. (1846–48, with abstract to 1855). London, 1857. 4to.

Sabine, Col. E., R.A. On the Lunar Diurnal Variation at Toronto [Excerpt from Phil. Trans., 1856]. 1857; 4to.

Kingston, Prof. G. T. Results of Meteorological Observations made at the Magnetical Observatory, Toronto, Canada West, 1860–62 inclusive. Toronto, 1864. Small 4to.

Kingston, Prof. G. T. Abstracts of Meteorological Observations made at the Magnetical Observatory, Toronto, Canada West, 1854 to 1859 inclusive. Toronto, 1864. Small 4to.

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* Referring probably to General Sabine's three large quarto volumes.

Kingston, G. T. Instructions to Meteorological Observers, in correspondence with the Magnetic Observatory, Toronto. 8vo. 1871.

Kingston, G. T. General Meteorological Register for 1871. 8vo.

Kingston, G. T. General Meteorological Register for 1872. 8vo.

Kingston, G. T. General Monthly Meteorological Register for 1873. Toronto.

Kingston, G. T. Second Report of the Meteorological Office of the Dominion of Canada. Ottawa, 1873. 8vo.

Kingston, G. T. General Meteorological Register for 1873. 8vo. Toronto, 1874.

Kingston, G. T. Third Report of the Meteorological Office of the Dominion of Canada. Ottawa, 1874. 8vo.

Kingston, G. T. General Meteorological Register for 1874. 8vo.

Kingston, G. T. Reports on the Meteorological, Magnetical, and other Observatories of the Dominion of Canada for the year 1874. 1875. 8vo.

Kingston, Prof. G. T. Abstracts and Results of Magnetical and Meteorological Observations at the Magnetic Observatory, Toronto, Canada, from 1841 to 1871 inclusive. Toronto, 1875. 8vo.

We now pass to the results, and the first which we notice is so startling that we reproduce the paragraph :—

During and prior to the time when the observations were made, on which General Sabine based his conclusions (1841-52), the mean temperature of January exceeded very decidedly the mean of February in other parts of North America, as well as at Toronto. Testimony to this effect is given by Dove, who describes the isothermal lines as moving southwards from January to February. Observations of subsequent years, however, at other places, even more than at Toronto, show a preponderance in the temperature of February, thus :—

			deg.
At Isle Jesus (near Montreal)	1853-62,	February was warmer than January by	3·4
Quebec	1860-67,	,, ,, ,,	3·6
St. John, New Brunswick...	1861-68,	,, ,, ,,	3·6
Halifax	1867-69,	,, ,, ,,	2·3
Stratford, Ontario	1861-69,	,, ,, ,,	1·8
Toronto	1859-68,	,, ,, ,,	1·9

That the change in the time when the greatest cold occurs in Toronto has been a progressive change, is shown by comparing the means of January and February in groups of five years :—

	deg.		deg.
1841-45, Jan. warmer than Feb. by	2·6	1856-60, Jan. colder than Feb. by	0·3
1846-50, ,, ,, ,,	2·6	1861-65, ,, ,, ,,	1·5
1851-55, ,, ,, ,,	0·9	1866-69, ,, ,, ,,	2·1

If the alteration here implied really exists, it is a most important fact. We have, therefore, devoted some care to its examination, especially as Prof. Kingston immediately drops the subject. The first thing is to get at all the precise facts which have yielded the above mean values: they are given in the following table, which is formed from Table IV. of the work under notice, and completed from Prof. Kingston's General Meteorological Registers.

Difference between the mean temperature of January and February in each year, from 1841 to 1871, both inclusive.

Year.	Amount. deg.	Year.	Amount. deg.	Year.	Amount. deg.	Year.	Amount. deg.
1841	— 3·2	1851	+ 2·1	1861	+ 6·4	1871	+3·0
2	— 1·0	2	+ 5·0	2	+ 0·9	2	—1·7
3	—14·2	3	+ 1·3	3	— 5·4	3	+3·8
4	+ 5·8	4	— 2·3	4	+ 1·5	1874	—2·0
5	— 0·5	5	—10·3	5	+ 4·7		
6	— 6·3	6	— 0·2	6	+ 1·8		
7	— 1·8	7	+16·0	7	+11·3		
8	— 2·1	8	—12·9	8	— 1·8		
9	+ 1·0	9	— 0·2	9	— 2·7		
1850	— 3·7	1860	— 0·3	1870	— 2·9		

— denotes February colder than January.

The first thing which strikes one in this table is the magnitude of the difference in some years. Evidently the low mean temperature of February, 1843, (14°·2 below that of January*) is the cause of nearly half the deficiency found in the first ten years, and similarly the excess in the decade (1861–70) is considerably augmented by the excess of 11°·3 in 1867. Still the fact that the plus signs denoting excess of February temperature above that of January are only 2 in the first decade, while there are 4 in the second, and 6 in the third, certainly indicates something more than an accidental disturbance due to a few exceptional incidents. The thorough examination of this subject would be altogether unsuited to a mere review, but we believe that the question is worthy of it, for if it be possible to trace the effect of the clearance of vast woods, and the cultivation of previously waste tracts, surely America is the place where this will be most easily done, for, contemporaneously with its great material progress, very fairly accurate and long continued series of observations have been made and published.

Prof. Kingston appears to share with some other meteorologists a love for means far greater than for extremes. We believe that extremes are of at least equal importance, and have, therefore, hunted out the following facts.

	Temperatnre in Shade. deg.		Pressure at 342 ft. + Sea Level. in.		Yearly Rainfall (Rain & Snow). in.	
Highest	99·2	Aug., 1854	30·940	Jan., 1866	46·19	1870
Mean...	44·2		29·621		35·62	
Lowest.	—25·4	Feb. 1855	28·166	Jan., 1870	26·18	1848
Range..	124·6		2·774			

The greatest fall of rain in one day was in September, 1843, viz., 3·46 in. Useful tables of the frequency of auroræ, of thunderstorms, hail, fog, &c., are also given, as well as daily meteorological abstracts for the years 1863 to 1871 inclusive.

* This prevailed over the whole of N. America, the greatest difference being in the North West; at Fort Snelling, Minessota (Lat. 44° 53′, Long 93° 10′ W.) the mean temp. of February was 18°·7 below that of January.

Results of Observations in Meteorology, Terrestrial Magnetism, &c. taken at the Melbourne Observatory, during the year 1872 *; with abstracts from Meteorological Observations at various localities in Victoria.* By R. L. J. ELLERY, Government Astronomer. Vol. I. Melbourne : John Ferres. (No date).

GREAT was our surprise at seeing "Vol. I." on the cover of this work, as we knew that Melbourne observations extend back to 1840. The first few sentences of the preface cleared up the mystery, and are so terse and to the point that we reprint them.

"The first results of Meteorological and Magnetical Observations made at the Melbourne Observatory were published in 1859 in a volume entitled 'Results of the Magnetical, Nautical, and Meteorological Observations, Melbourne,' and in 1863 in a volume entitled 'Meteorological and Nautical Observations, 1859 to 1862, Melbourne.' Since the issue of the latter volume there was no publication of the Meteorological or other Physical Observations made here until January, 1872, when the 'Monthly Record of the Observations made at the Melbourne Observatory in Meteorology, Terrestrial Magnetism, &c.,' was first issued.

"The present volume is simply an annual issue of these records, to which is appended a series of tables, abstracts and means, deduced from the year's observations.

"It is hoped that the present arrangement of the results of the Melbourne Observations will be found of value to the scientific enquirer as well as to the general public ; for while they have been condensed as far as appeared consistent with scientific value, the methods of reduction, as well as carefully computed tables of averages and means, are added, so as to give to the meteorologist all data—short of the record of the observations themselves—from which to make deductions respecting the climate of the colony of Victoria, or from which to obtain information relative to various meteorological and physical conditions ruling in this portion of Australia.

"The observations from which the following results have been obtained have been for the most part made at this Observatory, under the charge of Mr. C. Moerlin, second assistant ; while those from other parts of the colony have been made by the gentlemen whose names appear in the abstracts pertaining to the several localities."

We think that Mr. Ellery might have added a paragraph respecting the Flagstaff Observatory, and Dr. Neumayer's publications connected therewith. Possibly if we possessed the two works mentioned by Mr. Ellery we might find in them that which, even in that case, should still have been reprinted in the inaugural volume of what, we hope, will be a long series of annual reports.

We believe that the observations at the Flagstaff Observatory extended from 1858 to 1863, inclusive, and that the publications connected with that establishment were :—

Neumayer, G. Results of the Meteorological Observations taken in the Colony of Victoria during the years 1859-62. 4to. 1864.

Neumayer, G. Results of the Nautical Observations collected and discussed at the Nautical Observatory, Melbourne, 1858-62. 4to. 1864.

Neumayer, G. Discusssion of the Magnetical and Meteorological Observations made at the Flagstaff Observatory, Melbourne, 1858-63. 4to. 1867.

Dr. Neumayer, in the preface to the last-mentioned work, is not accurate in his reference to his own publications, which he refers to as "Results, Vol. I." and "Results, Vol. II.," although we believe no such numbers are placed upon the books. We are not *certain*, not

having seen them. This, however, is nothing compared with the unertainty in which Mr. Ellery leaves his readers, through the absence of about one page of letter-press and, perhaps, half-a-dozen pages of tables. We do not ask that he should copy the Greenwich plan, and *every year* print a full history of his observatory and of all its instruments; but we do consider that to render the work complete, the first volume of the series should have contained a brief history of the Observatory, with a view of it, and a ground plan, and that there should have been given tables of the principal results used as standards of comparison. For instance, on page 136 there is a very useful and valuable table showing the difference of the principal elements in 1872 from the average of previous years; but there is nothing to show where the observations (whence these averages have been computed) were made, or what or when changes in the modes of observation have been introduced.

We are glad to conclude by congratulating Mr. Ellery on all the rest of the volume, on the good distribution of his country stations, and the completeness of his abstracts, especially those of heavy rainfall, and, though last by no means least, upon the clearly printed map of the stations.

SUPPLEMENTARY TABLE OF RAINFALL IN DEC., 1875.

[For the Counties, Divisions, Latitudes, and Longitudes of these Stations, see Met. Mag., Vol. X., p. 28.]

Station.	Total Rain.	Station.	Total Rain.
	in.		in.
Acol	1·33	Gainford	1·92
Hailsham	1·46	Shap	7·14
Strathfield Turgiss	1·08	Llanfrechfa	3·50
Addington Manor	1·37	Castle Malgwyn	3·83
Oxford	·86	Heyope	2·60
Cambridge	1·01	Melrose	2·07
Sheering	1·20	Cessnock, Glasgow	5·03
Ipswich	1·29	Gruinart	...
Diss	1·97	Keith	2·73
Swaffham	1·73	Strathconan	5·54
Compton Bassett	1·07	Springfield, Tain	2·05
Hessary Tor, Dartmoor	4·11	Skibbereen	2·73
Teignmouth	1·25	Fermoy	3·28
Torrington	2·45	Kilrush	2·97
Trevarrick, St. Austell	2·46	Kilkenny	1·73
Taunton	·88	Kilsallaghan	1·75
Cheadle	1·66	Twyford, Athlone	2·54
Ashby de la Zouch	1·55	Ballinasloe	3·04
Coston, Melton Mowbray	1·94	Kylemore	9·11
Bucknall	·99	Bangor	4·24
Mansfield	1·54	Carrick on Shannon	1·96
Walton, Liverpool	1·06	Warrenpoint	3·05
Broughton-in-Furness	4·00	Bushmills	2·61
Stanley, Wakefield	·79		

DECEMBER, 1875.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1860–5	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Date.	Min. Deg.	Date.	No. of Nights below 32°. In shade	On grass
		inches	inches.	in.								
I.	Camden Town	·94	— ·56	·26	2	15	54·8	22	23·2	4	10	12
II.	Maidstone (Linton Park)	2·30	+ ·47	·95	6	14	54·0	22	20·0	7	11	...
,,	Selborne (The Wakes)	1·61	— 1·14	·39	21	11	51·0	24	18·0	4	12	13
III.	Hitchen	1·04	— ·27	·41	2	13	51·0	21†	19·0	5	14	...
,,	Banbury	1·12	— ·55	·26	2	14	53·0	21†	22·0	6	14	..
IV.	Bury St. Edmunds (Culford)	1·84	+ ·35	·40	4	17	55·0	22	16·0	3	12	14
V.	Bridport	1·28	— 2·09	·50	2	9	54·0	22	18·0	4	...	...
,,	Barnstaple	2·02	— 1·10	·43	21	15	56·0	22	22·0	6	...	...
,,	Bodmin	2·79	— 2·45	·88	18	18	52·0	22	23·0	18	8	12
VI.	Cirencester	1·64	— ·65	·46	31	8	...	...	...	...	...	...
,,	Shifnal (Haughton Hall)	1·03	— ·65	·46	31	9	52·0	21	22·0	6,7	12	15
,,	Tenbury (Orleton)	1·63	— ·83	·53	31	14	55·0	22	24·0	6	14	16
VII.	Leicester (Belmont Villas)	1·33	...	·29	2	13	54·8	22	24·8	6	10	..
,,	Boston	1·20	— ·29	·32	5	13	56·0	21	27·0	8	13	...
,,	Grimsby (Killingholme)	1·31	...	·19	4	18	54·0	21	29·0	6	5	...
VIII.	Manchester	..	...	...	...	...	...	...	...	...	...	...
IX.	York	89	...	·17	4	12	...	...	...	...	...	..
,,	Skipton (Arncliffe)	4·79	+ ·24	1·11	21	21	48·0	27	15·0	14	14	...
X.	North Shields	1·44	— ·76	·36	2	18	52·5	21	27·8	16	9	17
,,	Borrowdale (Seathwaite)	13·93	— 3·02	3·19	20	17	...	...	...	...	...	...
XI.	Cardiff (Ely)	2·03	— ·57	·57	20	15	...	...	...	...	...	...
,,	Haverfordwest	3·93	— ·90	1·50	18	9	53·0	21	19·0	5	14	18
,,	Rhayader (Cefnfaes)	...	...	...	..	...	...	...	...	...	...	...
,,	Llandudno	1·41	— ·79	·61	21	7	58·0	20	31·8	6,7‡	...	...
XII.	Dumfries (Crichton Asylum)	3·06	— ·96	·85	21	16	51·6	22	22·8	6	13	13
,,	Hawick (Silverbut Hall)	2·64	...	1·15	21	12	...	...	...	...	...	...
XIV.	Kilmarnock (Annanhill)	2·50	...	·39	21	20	51·2	21	20·0	8	11	13
XV.	Castle Toward	...	...	...	...	...	...	...	...	...	...	..
XVI.	Leven (Nookton)	2·57	— ·21	·50	21	16	51·0	20	25·0	15	10	19
,,	Stirling (Deanston)	...	...	...	...	...	..	...	...	..	...	...
,,	Grandtully	4·00	...	·91	23	12	...	...	..	...	...	...
XVII.	Braemar	4·39	+ ·62	·88	21	15	48·2	26	11·8	4	11	21
,,	Aberdeen	1·92	...	·37	18	20	52·2	24	25·4	5	10	22
XVIII	Loch Broom	...	...	..	...	...	...	...	...	...	...	...
,,	Portree	8·56	— 7·07	1·06	24	27	...	...	...	...	...	...
,,	Inverness (Culloden)	2·33	+ ·40	·46	24	15	51·6	31	19·2	6	9	20
XIX.	Helmsdale	2·69	...	·72	25	22	...	...	...	...	...	...
,,	Sandwick	3·36	— ·61	·50	23	23	54·1	20	28·0	7	9	14
XX.	Caherciveen Darrynane Abbey	2·97	...	·76	30	12	...	...	...	...	...	...
,,	Cork	2·28	...	·40	18*	14	...	...	...	...	...	...
,,	Waterford	2·03	— 2·39	·62	21	12	55·0	20	26 0	9	12	...
,,	Killaloe	3·93	+ ·44	·60	21	13	...	...	...	...	...	...
XXI.	Portarlington	1·76	— 1·43	·45	18	18	54·0	21	22·0	5	13	...
,,	Monkstown, Dublin	1·38	— 1·24	·33	21	11	...	...	...	...	...	...
XXII.	Galway	2·89	...	·75	21	14	56·0	22	18·0	9	13	...
,,	Ballyshannon	1·93	...	·45	21	13	...	...	...	...	...	...
XXIII	Waringstown	1·61	...	·61	17	15	55·0	21	19·0	4,5	16	21
,,	Edenfel (Omagh)	2·50	...	·65	21	15	50·0	21	17·0	7	18	...

* And 31. † 22. ‡ 8.

+Shows that the fall was above the average; —that it was below it.

METEOROLOGICAL NOTES ON DECEMBER.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hail: S for Snow.

ENGLAND.

LINTON.—The snow which had commenced the last week in November received great additions on 2nd, 3rd, 5th, and 6th of December, and was in places drifted to a great depth, but a slow thaw taking place on 10th and 11th, it gradually disappeared with less flood than expected. High wind on 22nd; dense fogs on 16th, 18th, and 26th; bar. generally high during the month, and, strange to say, the ther. only once fell below freezing point after the 11th. The month may be described as the first ten days wintry, after that time mild, the last sixteen days particularly so for December.

SELBORNE.—The first half of the month remarkably cold, the second half unusually warm; the prevailing winds in the early part, N.E., passing round by N.W. and W. to S.W., the latter half; S daily during first week; fog almost daily from 8th to 20th inclusive; high wind on 22nd; cloudy from 25th to 29th inclusive.

CULFORD.—S almost daily to the 9th, fine from 11th to 20th, mild weather after the tenth day; mean. temp. of the month, 37°·7; easterly winds prevailing during twelve days.

BODMIN.—Mean. temp., 41°·7; R 2·16 in. below the average (26 years).

SHIFNAL.—The wind up to the 15th was N. and N.W., then S. and S.W. (with two exceptions) till the close. Although dry, it was cold beyond the average for the first ten days; the max. ther. never exceeded 36°·0, and the min. was below 32° each night; 3 in. of S fell on the 6th; on 21st a sudden rise in temp. took place, followed by a heavy gale from S.W. at night. From that day it continued mild, the vast display of holly-berries alone reminding one that it was winter.

ORLETON.—The weather throughout the month was cloudy and gloomy, and the sun was rarely visible. The air was cold with frosts almost every day till the 16th, when the wind changed to the S., and the remainder of the month was warm. The mean. temp. was a trifle higher than the average for the month. The wind was violent on 21st, 22nd, 23rd, and 31st. A heavy fall of R, succeeded by S, set in soon after 10 p.m. on the night of 31st; with this exception the falls of R were light.

LEICESTER.—S fell occasionally during the first week; latter half of the month very mild for the season; many roses in bloom in sheltered places on Christmas Day.

BOSTON.—A fine, mild, dry month, enabling the farmers to complete their wheat sowing, delayed by the rains of October and November. The rainfall of the month below the average.

GRIMSBY.—Mild month, the latter part especially so; some very pleasant days during the last week.

NORTH SHIELDS.—Aurora on 8th; L on 21st; S in the early part of the month, but fine during the last week.

SEATHWAITE.—R 3 in. below the average, though there were ten days on which the fall exceeded ·50 in., six on which more than 1·00 fell, and on one day (the 21st) 3·19 was measured.

WALES.

HAVERFORDWEST.—On the whole, a dry and cold month, the first 17 days very cold and frosty, then came a very wet stormy period of five days' duration; cloudy, misty, and mild from the 26th to 31st.

LLANDUDNO.—Dull and cold the first week, but very fine, dry, and mild the remainder of the month. Heavy gale on 21st.

SCOTLAND.

DUMFRIES.—Continuous frost up to the 12th, remainder of the month ver moist, with occasional heavy gales; rainfall ·40 greater than last December mean. temp. unusually high (38·8); H on 21st, and gale on 22nd.

SILVERBUT HALL, HAWICK.—Frosty at nights from 1st to 9th; Teviot in high flood on 21st, on which day 1·15 of R fell; winds changed often on 3rd and up to the 9th. The year departed in a storm of wind and R.

ANNANHILL.—From 1st to 9th cold, easterly winds, with low temperature and much frost, accompanied by a high bar., after which winds changed to westerly and S.W., and the temp. rose again, bar. falling with slight variations to the end of the month. The period of easterly winds was remarkable by the entire absence of ozone; after then it was well developed. Great storm on 23rd and 24th, W.S.W. gale, 70 miles an hour. There were also gales on 20th, 21st, 22nd, and 31st; T, L, H and R, on 22nd; temp. 1·95 less than November; much S fell during the first part of the month; death rate for the year 31 per 1000, total number of deaths 769, average mortality 603.

BRAEMAR.—L 22nd and 23rd.

ABERBEEN.—L 10 to 11 p.m. on 22nd, and at 8 p.m. on 23rd. Early part of the month cold, with S which never lay to the depth of 2 in.; the latter portion of the month rather mild, with frequent high winds.

PORTREE.—Wet and squally month; S and H 7th, 8th, and 11th; gale from W.S.W. to N.W. on 22nd, 23rd, and 24th; L on 20th and 21st at night; T and L, at night, on 22nd and 23rd; S, H, and sleet showers on 2nd, 3rd, and 4th. The rainfall greatly below the average.

SANDWICK.—The first part of December was generally frosty and calm, but after the 20th it was frequently stormy, with R and sleet. T and L on 22nd and 24th, and L on 23rd.

IRELAND.

DARRYNANE.—Fine, with N.E. winds and frost to the 11th; moderate gale from S.W. on the 12th, increasing to a heavy gale from the same point on the 14th; rest of month moderate westerly winds and variable weather; moderate gale from S.W. on night of 20th and 21st; and very heavy gale from N.W. on 22nd.

WATERFORD.—T, L, and H on 22nd.

MONKSTOWN.—Month commenced with unusual severity; frost and S for the first ten days; the Dublin mountains being white for more than a fortnight. There were several days' skating, which is very unusual here in December.

GALWAY.—L and T on the early mornings of 22nd and 23rd.

BALLYSHANNON.—The first part of the month was frosty, and up to the 17th almost entirely free from R; the latter part was wet and stormy, with much L and some very heavy H showers.

WARINGSTOWN.—Hard frost until the 11th, then a nice dry thaw, without R, till the 17th; the remainder of the month mild and fine, with occasional slight showers at night.

EDENFELL, OMAGH.—First half of the month fine and dry, with frost sufficently intense to freeze the lakes and rivers. Remainder of the month mild, wet, and unsettled.

END OF VOL. X.